II. MONITOR WATER RESOURCES

The Water Allocation Program EIR concluded that Water Supply Option V would have less-than-significant impacts on the water resources in the Monterey Peninsula area, and that no mitigation measures were required. This conclusion was based solely on changes to the hydrologic regime and not on changes to water-dependent resources. Impacts on water-dependent resources (e.g., riparian vegetation and wildlife and steelhead fishery) due to changes in the hydrologic regime were identified as significant in the EIR. Implementation of the mitigation measures proposed for the impacts on these water-dependent resources are described in subsequent sections. It was suggested in the EIR that the District continue and expand its current monitoring programs to establish baseline conditions for assessment of long-term changes (Finding No. 381). The District currently maintains precipitation, streamflow, storage, water level, and water quality monitoring programs. These programs and the activities to implement them, from October 2006 through September 2007, are summarized below.

A. Precipitation Monitoring

Description and Purpose

During the period from October 1, 2006 through September 30, 2007, the District continued to access long-term precipitation records at Los Padres and San Clemente Dams obtained from California American Water (Cal-Am or CAW) and maintained by the District. District staff also records precipitation at its Monterey office located at Ryan Ranch, and receives daily rainfall reports from the National Weather Service Climate Station, Monterey (maintained by R.J. Renard). In addition, real-time and historical rainfall data for the Monterey Peninsula area can be accessed via the Internet. These data support a variety of District programs, including erosion control, riparian vegetation management and identifying long-term precipitation trends and conditions.

Implementation and Activities During 2006-2007

Work during this period involved continuing maintenance of the existing precipitation monitoring network. A summary of daily precipitation at San Clemente Dam during Water Year (WY) 2007 (defined as October 1, 2006 through September 30, 2007) is shown in **Figure II-1**. In WY 2007, 11.81 inches of precipitation were recorded at San Clemente Dam. The average annual recorded precipitation at this site for the period from 1922 through 2007 is 21.40 inches, making rainfall in WY 2007 about 55 percent of average. **Figure II-2** shows a comparison of WY 2007 rainfall at San Clemente Dam and the average monthly rainfall at this site. As indicated in this plot, below average rainfall occurred during every month of WY 2007, except for September 2007.

B. Streamflow Monitoring

Description and Purpose

Since its inception, the District has collected streamflow measurements at approximately 15 mainstem sites on the Carmel River and on 16 tributaries to the Carmel River. The District's

principal streamflow measuring sites within the Carmel River Basin (CRB) are shown on **Figure II-3**. Prior to 1991, the streamflow measurements were instantaneous measurements made by the current meter method. In 1991, a concerted effort was made to upgrade the streamflow monitoring network as staff installed continuous recorders[1] at six selected tributary sites. Since that time, the District has continued to expand its streamflow monitoring network, which currently consists of 18 continuous recording gaging stations.

Data collected at the District streamflow monitoring sites are analyzed for use in water supply planning, fishery, riparian and erosion control programs. More specific uses of streamflow data include, but are not limited, to the items listed below:

- Defining the general hydrologic conditions in the basin
- Setting flow requirements for meeting aquatic life goals
- Monitoring compliance with minimum flow requirements
- Assessing and scheduling fish rescue activities
- Assessing effectiveness of riparian mitigations
- Evaluating surface and ground water interaction
- Developing and calibrating hydrologic models
- Delineating and managing flood plains
- Evaluating and designing water supply projects
- Providing data for forecasting floods and defining flood recurrence intervals
- Assessing hydrologic impacts from water development projects
- Supporting Aquifer Storage and Recovery (ASR) operations

Implementation and Activities During 2006-2007

During the 2006-2007 period, the District operated and maintained 15 streamflow gaging stations within the Carmel River Basin/District Boundary. In addition, continuous water level data were collected at both Los Padres and San Clemente Reservoirs, and at the Carmel River Lagoon. The District continuous recording gaging stations are listed below:

Tributary/other
Cachagua Creek
Pine Creek
San Clemente Creek
Tularcitos Creek
Hitchcock Creek
Garzas Creek near Lower Garzas Canyon
Garzas Creek at Garzas Road
Potrero Creek
Robinson Canyon Creek
San Jose Creek
Arroyo del Rey at Del Rey Oaks

Mainstem
Carmel River below Los Padres Reservoir
Carmel River at Sleepy Hollow Weir
Carmel River at Don Juan Bridge
Carmel River at Highway 1 Bridge

Continuous Water Level
Los Padres Reservoir
San Clemente Reservoir
Carmel River Lagoon

[1] The District utilizes both float gages and data recorders with pressure transducers to monitor stream stage.

Streamflow gaging station operations and maintenance (O&M) at each of the above sites involves obtaining monthly discharge measurements, maintaining recording equipment, obtaining staff gage readings and occasional surveying. Subsequently, river/creek stage and discharge data are processed in-house to produce mean daily streamflow records for the sites. **Table II-1** summarizes the computed annual flows for the District sites (with at least four years of continuous data) for the WY 1992-2007 period. In addition, **Table II-1** includes annual flow values for the two USGS operated mainstem sites for the 1992-2007 period in addition to the two MPWMD operated gauges.

During the 2006-2007 period, District staff continued to maintain the existing streamflow monitoring network. Streamflow within the Carmel River Basin during WY 2007 was classified as critically-dry. Despite the unusually dry conditions, significant staff time was spent collecting numerous, routine streamflow measurements by the current meter method, in order to refine the stage/discharge relation at the gaging stations. In addition, many low flow measurements were obtained at the sites utilizing a three-inch modified Parshall Flume. In between periods of streamflow related field work, 60 continuous (draft) streamflow records covering the WY 2004 – 2007 period were computed in preparation for completion of the Carmel River Basin Surface Water Data Report – Water Years 2004 – 2007, the fourth volume in a series of four-year reports. These 60 streamflow records will be reviewed for quality control prior to report publication.

Another major activity during the 2006-2007 period, was the installation and use of cell phone based telecommunications equipment at the Los Padres Reservoir, Camel River below Los Padres, and Carmel River Lagoon gage sites. This work involved the installation of an antenna, modem and solar panel at each of the field sites, as well as software installation and configuration at the District office. It should be noted that there are four additional District gage sites that include telecommunications equipment located at San Clemente Reservoir, Carmel River at Sleepy Hollow Weir, Carmel River at Don Juan Bridge and Carmel River at Highway 1 Bridge. In 2007, staff began to utilize the telecommunications capability on a weekly (sometimes daily) basis to post daily streamflow values on to the District's web site, to improve data dissemination to public and private groups. These streamflow data can be accessed via the Carmel River Flows section of the District's web site. In addition, the *Carmel River Lagoon Water Levels* section of the District's web site now provides access to continuous Lagoon water level data which are also updated daily or weekly.

- **Summary of Streamflow Conditions --** Streamflow during WY 2007 within the Carmel River Basin was classified as critically-dry. The heaviest storm flow event of the year occurred on February 27, 2007. Peak streamflow along the Carmel River on February 27 reached 293 cubic feet per second (cfs) and 244 cfs at the Don Juan Bridge and Highway 1 Bridge sites, respectively.

During WY 2007, 12,542 acre-feet (AF) of unimpaired runoff were estimated at San Clemente Dam. This total represents 18% of the average annual runoff (69,000 AF) expected at San Clemente Dam. **Figure II-4** shows a comparison of the actual and average cumulative unimpaired inflows at San Clemente Dam for WY 2007. This runoff provided streamflow to the ocean from February 11, 2007 through April 9, 2007. During this 57-day period, based on

hydrographic analysis, it is estimated that the Lagoon mouth was closed approximately 40 percent of the time, as numerous periodic closures occurred during this time frame.

C. Storage Monitoring

Description and Purpose

Since December 1987, the District has calculated end-of-month (EOM) storage values in the major reservoirs and aquifers within the Monterey Peninsula Water Resources System (MPWRS). The storage values for Los Padres and San Clemente Reservoir are estimated based on EOM water level elevations and area-elevation-capacity curves provided for each reservoir by Cal-Am. These reservoir storage values represent "usable" storage and are adjusted for dead storage and minimum pool requirements. The storage values for the Upper Carmel Valley (UCV) aquifer subunits, Lower Carmel Valley (LCV) aquifer subunits, and the Coastal Subareas of the Seaside Groundwater Basin are estimated based on groundwater levels observed in selected monitor wells measured by the District and Cal-Am. The aquifer storage values also represent "usable" volumes and are adjusted for water inaccessible to existing wells (i.e., below casing perforations) or held in reserve as a safeguard against seawater intrusion or other adverse environmental impacts. The current total usable storage capacity for the water resources system is 37,550 acre-feet (AF). Of this total, an estimated 1,550 AF are in reservoir storage and 36,000 AF are in aquifer storage. For this report, all reservoir storage values are rounded to the nearest 10 AF and all aquifer storage values are rounded to the nearest 50 AF.

These storage estimates are compiled by the District to provide a quantitative basis for managing the area's water resources. These estimates are used to make decisions regarding water production and water rationing. These estimates are also used to calibrate the District's Carmel Valley Simulation Model (CVSIM).

Implementation and Activities During 2006-2007

At the end of September 2007, system storage totaled 25,450 AF or 68 percent of capacity. This total was approximately 90 percent of the 28,350 AF storage that is expected under normal conditions at this time of the year. **Figure II-5** shows a monthly comparison of usable system storage versus average system storage during the October 2006 – September 2007 period. Of the total storage at the end of September 2007, an estimated 640 AF were in Los Padres and San Clemente Reservoirs, 22,760 AF were in the Carmel Valley Alluvial Aquifer, and 2,050 AF were in the Coastal Subareas of the Seaside Groundwater Basin.

It should be noted that the remaining usable storage capacity in San Clemente Reservoir was constrained in June 2003 when Cal-Am, at the direction of the California Department of Water Resources (DWR), was required to lower the water level in the reservoir from elevation 525 feet above mean sea level (msl) to elevation 514 feet msl. This “drawdown” project is required by DWR as an interim safety measure at San Clemente Dam and remained in effect in Water Year 2007. As constrained by DWR, usable storage capacity in San Clemente Reservoir during the high-flow season (February - May) is limited to approximately 70 AF and during the low-flow period (June - January) is limited to less than 10 AF.

D. Groundwater Level Monitoring

Description and Purpose

The District maintains a groundwater level monitoring program in the Carmel Valley aquifer and the Seaside Groundwater Basin. The data collected as part of this program are used to support a variety of programs, including storage monitoring, compilation of annual and long-term well hydrographs, water table contour mapping, Carmel River Management Program, Seaside Basin Watermaster Program, and other special projects. The monitor well measurements are stored in a database program developed by the District to facilitate data entry, access and manipulation of the water level data. In addition, groundwater level measurements are collected on a regular basis by CAW from each of their production wells, and these measurements are also utilized in the District's program.

Implementation and Activities During 2006-2007

- **Carmel Valley Aquifer --** The District's monitor well network in the Carmel Valley aquifer consists of dedicated monitor wells and several private production wells, and currently totals approximately 50 water level monitoring wells. During this period, the wells were measured on a monthly basis, and these measurements were used to compute end-of-month storage volume estimates for the aquifer. In addition, more frequent monitoring of selected wells was conducted during winter storm events to more closely monitor aquifer recharge.

Figure II-6 is a typical hydrograph from the lower Carmel Valley, showing groundwater level fluctuations at the Rancho Cañada East monitor well (River Mile 3.13), compared with mean daily streamflow in the Carmel River at Highway 1 (River Mile 1.09). This monitor well is located nearby the most westerly CAW production well in Carmel Valley, the Rancho Cañada well. The monitor well is located approximately 375 feet from the river channel, and about 250 feet from the Rancho Cañada well. As shown on this figure, the groundwater elevation increased approximately 11 feet between the beginning of February 2007 and the middle of May 2007, due to the reduced groundwater production at this time of the year, combined with the resumption of Carmel River flows in this lower reach of the river. Groundwater levels declined steadily from May through September 2007 in response to receding surface flows and increased groundwater pumping, and at the end of WY 2007, the groundwater elevation in this well was about six feet lower than at the start of Water Year 2007.

The hydrograph of a monitor well closer to the coast is shown in **Figure II-7**. This monitor well, the CAWD-Rio North well, is located at River Mile 1.65, and approximately 850 feet from the river channel. At this location, the magnitude of seasonal water level fluctuation, approximately four feet, is significantly less than at the Rancho Cañada East monitor well, due to its location farther from the river and major production wells in the lower Carmel Valley. Typically, a seasonal rise in water level at the CAWD-Rio North well lags relative to the Rancho Cañada East monitor well, although this phenomenon is not apparent from the data for WY 2006-2007 due to the timing of measurements. The lag time is a response to the effect of distance from the river channel on the timing of groundwater recharge from river flow events.

During WY 2007 period, the monitoring data indicated that groundwater storage in the Carmel Valley aquifer remained relatively full during the water year. In the river reach between San Clemente Dam and the Narrows (i.e., aquifer subunits 1 and 2), the lowest storage capacity estimate was 88% of capacity at the end of September 2007. Similarly, in the river reach from the Narrows to the Carmel River Lagoon (i.e., aquifer subunits 3 and 4), the lowest storage capacity estimate was 78% of capacity at the end of September 2007. The aquifer remained relatively full during the year due to a number of factors, including:

- Availability of adequate base flows during spring and early summer months,
- Timing and magnitude of controlled river releases from the upstream reservoirs,
- Maximized dry-season production from CAW wells in the Seaside Basin,
- Water supply management practices implemented by the District in coordination with CAW, the California Department of Fish and Game and the National Marine Fisheries Service, as part of the Quarterly Water Supply Strategy and Budget process, and
- State Water Resources Control Board (SWRCB) Order No. WR 95-10 (and subsequent amendments) and the Seaside basin adjudication decision, which constrain CAW production from the Carmel River and Seaside Groundwater Basins, respectively.

● **Seaside Groundwater Basin --** In the Seaside Basin, monthly water level measurements were collected from 16 monitor wells in the Seaside Coastal Subareas, and four were monitored in the Seaside Inland Subareas. An additional 18 wells in the Seaside Inland and Laguna Seca Subareas were monitored on a quarterly schedule during the year. These additional wells are a combination of active or inactive production wells, and dedicated monitor wells.

Figure II-8 shows water level data available from representative wells in the coastal Seaside Basin monitor well network. These graphs show the water level elevations in the two principal aquifer zones, the shallower Paso Robles Formation and the deeper Santa Margarita Sandstone, at both upgradient (Site FO-07) and downgradient (Site PCA East) locations from CAW's largest capacity production well, the Paralta well. The graphs illustrate the more dominant effect that production from the Paralta well has had on water levels in the Santa Margarita Sandstone, which is the aquifer zone from which the Paralta well obtains most of its production. The graphs also illustrate the effect of changed water supply practices resulting from SWRCB Order WR 95-10. Under the Order, CAW has been directed to maximize production from its Seaside Basin sources as a means to reduce production and associated impacts from the Carmel River system. Seasonal recoveries associated with short-term reduced wintertime production and District aquifer storage and recovery (ASR) injection testing have not been sufficient to reverse the observed downward water-level trend. Discussion of the District's Phase 1 ASR Project is included in Section VI.

E. Groundwater-Quality Monitoring

Description and Purpose

The District maintains an ongoing groundwater-quality monitoring program for the two principal groundwater sources within the District: the Carmel Valley alluvial aquifer, and the Seaside Basin Coastal Subareas. The purpose of the program is threefold:

(1) to characterize the quality of water in the aquifers,
(2) to detect groundwater contamination from septic systems or other sources in the shallow zones of the Carmel Valley aquifer, and
(3) to monitor seawater intrusion potential in the coastal portions of the Carmel Valley aquifer and Seaside Basin.

The District has maintained a groundwater-quality monitoring program for the Carmel Valley aquifer since 1981, and for the Seaside Basin since 1990. The District's program is in addition to the extensive water-quality monitoring that is conducted by CAW. The District manages all well construction, maintenance, and field sampling activities associated with the program. Water samples are analyzed at a State-certified environmental testing laboratory. The Monterey County Health Department, CAW, and the Monterey County Water Resources Agency have also provided assistance with this program in the past. Collection of the water-quality data is intended to detect problems before they can affect the community's water supply.

Implementation and Activities During 2006-2007

Currently, the sampling schedule for Carmel Valley is staggered, with Upper Valley wells (i.e., upgradient of the Narrows) sampled in Spring and Lower Valley wells (i.e., downgradient of the Narrows) in Fall, to coincide with the historically higher nitrate concentrations in these respective areas. Collection of samples from the Seaside Basin monitor wells is conducted once per year in Fall, coinciding with the historically low water levels in the basin at that time of the year. It should be noted that, in 2007, the District staff initiated quarterly sample collection from six of the wells in the Seaside Basin monitoring network located closest to the coastline. This sampling is under contract for the Seaside Groundwater Basin Watermaster.

- **Carmel Valley Aquifer –** During WY 2007**,** groundwater-quality data were collected from a network of eight monitor wells in the Carmel Valley aquifer in November 2006, and three wells in the upper Carmel Valley area in April 2007. The results indicated that, in general, there were only minor changes in overall water quality compared to samples collected in the previous year. Staff is particularly interested in tracking indicators of potential seawater intrusion in the coastal portion of Carmel Valley. Accordingly, three sets of wells were established west of Highway 1, with each set being made up of three wells completed at different depths. Review of historical data indicated that the shallower and intermediate wells in the coastal area are subject to the mixing of fresh water and saline water as high tides and surf overtop the sand berm between the lagoon and the ocean. This contributes to episodic mixing within the shallower and intermediate zones of the aquifer, but is not necessarily representative of larger-scale potential seawater intrusion into the aquifer. Currently, only the deeper wells at each of the three coastal locations are sampled.

Well 16S/1W-14Jg is the deepest in the array of three wells located at the Carmel River State Beach parking lot at River Mile (RM) 0.07 (approximately 375 feet from the shoreline). **Figure II-9a** shows that specific electrical conductance (SEC), a measure of Total Dissolved Solids concentration, and chloride concentration noticeably increased in this well in November 2006 for the second year in a row, but these levels have not approached the levels observed at this location in the early 1990's. These higher values observed early in the period of record at this site are at

least partially attributable to the fact that there was no fresh water surface inflow to the lagoon for approximately four years (April 1987 until March 1991). This lack of freshwater inflow for local groundwater recharge, combined with the proximity to the ocean and the permeability of the alluvial sediments, allowed for inland movement of the freshwater / seawater interface past this site near the end of the 1987 – 1991 drought period. It should also be noted that the data from the District's monitor well network indicate that nitrate concentrations in the shallow zone of the aquifer are well below the State drinking water standard of 45 milligrams per liter (mg/L). The highly permeable nature and flushing effect of the aquifer have prevented long-term build-up of contaminants as can occur in more poorly recharged aquifer systems.

Graphs of water-quality data at the two coastal sites located farther from the shoreline show that SEC and chloride concentration slightly decreased from WY 2006 to WY 2007 at well 16S/1W-13Md, located at RM 0.31 from the shoreline (**Figure II-9b**), and increased slightly from WY 2006 to WY 2007 at well 16S/1W-13Lc, located at RM 0.65 (**Figure II-9c**). At both sites, there is a slight trend toward increased levels over the period of record. As noted in prior reports, the anomalously high SEC and chloride concentration in well 16S/1W-13Lc in WY 2001 are suspicious. Additional background on historical water quality at the coastal monitor well sites can be found in District Technical Memorandum 90-04, *Summary of Carmel Valley Groundwater Quality from Coastal Monitor Wells*, which is available at the District office. Staff will continue to track future results for trends that might indicate significant changes or emerging trends in concentrations of these or other constituents in the coastal area of the aquifer.

For the five wells located farther inland, changes in SEC and chloride concentration did not vary significantly from the previous year's sample results. The graph in (**Figure II-9d)** shows SEC and chloride concentration in well 16S/1E-23La, located at RM 6.72. The increased levels of SEC and chloride concentration that were observed in this well in WY 2006 had returned nearly to WY 2005 levels in WY 2007. The high chloride concentration in well number 16S/1E-23La in WY 1993 is anomalous. Staff will continue to track future results for trends.

One other well, 16S/1E-23E4, located at RM 6.53, yielded anomalous results for a number of constituents in WY 2007, most notably the concentration of iron. It is noted that during the intervening year since this well was last sampled, the wellhead had been covered with debris from construction activities in the vicinity and the area had been flooded with runoff from Schulte Road. It should also be noted that the battery-powered pump that is used to flush the well casing and obtain samples was not operating to its optimum capacity at this site when it was sampled in WY 2007. It is likely that the well was contaminated by surface runoff and that the well was not fully evacuated of the standard three casing volumes prior to sampling. Extra effort will be employed at this site in the future to ensure the restoration of this well and the reliability of data acquired. To this end, District staff is planning to reconfigure the well head at the site in 2008 to eliminate surface runoff contamination potential.

- **Seaside Groundwater Basin --** Twelve monitor wells in the coastal subareas of the Seaside Basin were sampled in October 2006, i.e., WY 2007. This total includes two wells that were added to the monitor-well network in 1997 and two that were added in 1999. The water-quality results from the Seaside Basin indicate that very little water-quality changes have occurred over the period of record at these sites since monitoring began in 1990, and that there is

no indication of seawater intrusion in this area of the basin at this time. Part of the function of the District's monitor-well network in the Seaside Basin is to serve as an early warning of potential seawater intrusion into the two principal aquifer zones, the Paso Robles Formation and the Santa Margarita Sandstone. **Figure II-9e** shows SEC and chloride concentrations in two coastal wells for the historical period of record beginning in April 1991. Results from the District's monitoring program indicate that SEC averages approximately 350 and 825 micromhos/centimeter, for the Paso Robles and Santa Margarita aquifer zones, respectively.

F. Carmel River Surface Water Quality Monitoring

Description and Purpose

This monitoring is used to help assess whether or not water-quality criteria for aquatic life are being met in various reaches of the Carmel River, and whether resources such as Carmel River steelhead (*Oncorhynchus mykiss*) and red-legged frogs (*Rana aurora draytonii*) are being sustained or impaired. Monitoring also provides District staff with a way of measuring trends over extended time periods. These data are used for recommending appropriate reservoir release schedules and for determining the timing of fish rescues.

Since 1991, surface water quality data have been collected at three sampling stations along the Carmel River on a semi-monthly basis. The locations of the sampling stations are as follows: (1) below Los Padres Reservoir at River Mile (RM) 25.4, (2) below San Clemente Reservoir at the Sleepy Hollow Weir (RM 17.1), and (3) at the Carmel River Lagoon (RM 0.1). River miles are measured from the mouth of the Carmel River. Monitoring at these specific stations provides District staff information on the quality of water released from each reservoir and in the surface layer of the lagoon.

District staff also monitors river temperatures continuously at six locations within the Carmel River Basin (**Figure II-2**). The objective is to document the temperature regime in different stream reaches and to determine whether water-quality criteria for maximum stream temperatures are exceeded. In addition, these data allow District staff to monitor changes in the thermal regime of the river over time.

Implementation and Activities During 2006-2007

District staff carried out a semi-monthly surface water quality sampling program; data were collected for the following chemical and physical parameters: temperature (°F), dissolved oxygen (mg/L), carbon dioxide (mg/L), pH, specific conductance (uS/cm), salinity (ppt), and turbidity (NTU). The emphasis for this suite of parameters is on the suitability for rearing juvenile steelhead. In addition, continuous recording temperature data loggers (Optic StowAway temperature data loggers from the Onset Computer Corporation) were deployed at six locations on the Carmel River (**Figure II-2**), as follows:

1. ALP Above Los Padres Reservoir (RM 27.0)
2. BLP Below Los Padres Reservoir (RM 25.4)
3. ASC Above San Clemente Reservoir (RM 18.5)

4. SHW	Sleepy Hollow Weir	(RM 17.1)
5. GAR	Garland Park	(RM 10.8)
6. SAL	South Arm Lagoon	(RM 0.1)

The following paragraphs describe the results of the semi-monthly data collection and the continuous temperature recorders at specific sampling stations.

- **Carmel River Lagoon--** Water temperature for the Carmel River Lagoon was sampled in the south arm of the lagoon on the Carmel Area Wastewater District (CAWD) sewer pipe. Water temperature for the South Arm Lagoon (SAL) station is shown in **Figure II-11**. Water temperature was collected in the south arm from July 1, 2006 to November 28, 2006 and December 5, 2006 to June 30, 2007. There were no data collected from November 29, 2006 to December 4, 2006 due to a data logger malfunction. The maximum annual water temperature of 77.7 degrees Fahrenheit (°F) occurred on July 25, 2006. Average annual water temperature at this station during the sampling period was 60.2°F. Average daily water temperatures over 68°F occurred 72 times or 20% of the time. Constant temperatures over 68°F are considered stressful for steelhead (Brungs and Jones, 1977). Water-quality data collected at the Carmel River Lagoon (CRL) station near the rock outcrop at the southwest end of the lagoon is listed in **Table II-2**. The minimum dissolved oxygen measurement recorded was 9.0 mg/L. The pH measurements ranged from 7.4 to 8.5. Carbon dioxide measurements ranged from 10 to 30 mg/L. The conductivity measurements ranged from 517 to 10,470 uS/cm. The surface salinity ranged from 0 to 4.5 ppt. The conductivity and salinity are highly variable at the lagoon due to tidal influences and river inflows. The turbidity measurements ranged from 0.3 to 6.0 NTU. Summertime water temperatures were within stressful ranges and probably decreased growth rates and survival capabilities. Steelhead likely searched for cold water refuges within the lagoon. Carbon dioxide measurements also spiked at the end of spring, causing increased stress to steelhead. This is usually caused by an increase of marine organic debris entering the lagoon during high surf events. Carbon dioxide is a byproduct of decomposition of this material.

- **Garland Park--** Water temperature for the Garland Park (GAR) station is shown in **Figure II-12**. The maximum annual water temperature was 69.6°F, occurring on July 22, 2006. Average water temperature during the reporting year at this station was 55.2°F. Maximum daily average water temperature was 65.8°F occurring on July 23, 2006. Daily average water temperatures were within adequate range for steelhead rearing during the entire reporting year.

- **Sleepy Hollow Weir--** Water temperature for the Sleepy Hollow Weir (SHW) station is shown in **Figure II-13**. The maximum annual water temperature was 76.8°F on July 24, 2006. Average water temperature during the reporting year at this station was 57.0°F. The maximum daily average water temperature was 74.4°F occurring on July 24, 2006. Water-quality data collected at this station is listed in **Table II-3**. The minimum dissolved oxygen measurement recorded was 9.0 mg/L, which is within the suitable criteria recommended by the Environmental Protection Agency (EPA) for steelhead (Chapman, 1986). Carbon dioxide measurements ranged from 5-15 mg/L. The pH

measurements ranged from 7.5 to 8.0. The conductivity measurements ranged from 252 to 352 uS/cm. The semi-monthly turbidity measurements recorded were between 0.0 to 6.9 NTU. None of the parameters measured were harmful to steelhead with the exception of high average water temperatures during the months of July and August. The high average water temperatures were in the suboptimal range during these months for steelhead.

- **Above San Clemente Reservoir--** Water temperature for the Above San Clemente (ASC) station is shown in **Figure II-14**. Nine days of data were lost at this station during the reporting year due to data logger malfunctioning. The loss of data was during November 22, 2006 through November 30, 2006. Maximum thermal regime is generally sampled from June through August. District staff is confident that the maximum thermal regime is represented within this data set for the reporting year. The maximum annual water temperature was 74.9°F on July 22, 2006. Average water temperature during the reporting period at this station was 56.5°F. Maximum daily average water temperature at this station was 71.2°F, occurring on July 23, 2006. The maximum daily average water temperatures during the months of July 2006, August 2006 and June 2007 were within suboptimal range and considered stressful for steelhead rearing. The rest of the reporting year water temperatures were within optimal rearing ranges.

- **Below Los Padres Reservoir--** Water temperature for the Below Los Padres (BLP) station is shown in **Figure II-15**. There was a loss of data from the temperature sensor during November 22, 2006 to June 30, 2007. This loss of data was due to the data logger malfunctioning. Sampling period for this reporting year is July 1, 2006 to November 21, 2006. Maximum thermal regime typically occurs during the July to August months, therefore staff does believe that the maximum thermal regime was observed for the reporting year. The maximum annual water temperature was 76.9°F occurring on July 26, 2006. Average water temperature at this station was 64.7°F. The maximum average water temperature at this station was 75.3°F on July 26, 2006. Water-quality data collected at this station is listed in **Table II-4**. Water quality at this station is highly influenced by reservoir water quality and release location. The minimum dissolved-oxygen measurement recorded was 4.0 mg/L, occurring on June 1, 2007, which is out of the range of suitable criteria recommended by the EPA for steelhead. Fortunately, the dissolved oxygen did not stay that low for a long period of time, staff recorded dissolved oxygen of 7.0 mg/L on the next sample at this station. Carbon dioxide measurements ranged from 5 to 15 mg/L. The pH and conductivity measurements ranged between 7.0 to 7.8 and 233 to 323 uS/cm, respectively. Turbidity measured at this station ranged from 0.0 to 4.8 NTU. While the instantaneous water temperatures exceeded the optimal levels for steelhead rearing, the average daily temperatures were always adequate. Other water-quality parameters measured were within the adequate range for steelhead with the exception of dissolved oxygen. The low dissolved-oxygen measurement recorded likely redistributed steelhead to improved conditions during this short time period.

- **Above Los Padres Reservoir--** Water temperature for the Above Los Padres (ALP) station is shown in **Figure II-16**. The maximum annual water temperature was 73.1°F, occurring on July 23, 2006 and July 24, 2006. Average water temperature during the

reporting period was 53.1°F. Maximum daily average water temperature at this station was 70.8°F occurring on July 24, 2006. Water temperatures during the end of July 2006 were considered stressful to steelhead. Water temperatures during the rest of the reporting year were within the adequate range for steelhead rearing.

G. Carmel River Lagoon Water Level Monitoring

Description and Purpose

Since 1987, the District has monitored the level of surface water in the Carmel River Lagoon. The water level is monitored with a continuous recorder located in the South Arm of the Lagoon that utilizes pressure transducer technology. The water level data have been used, in part, to support technical studies for use by the Carmel River Steelhead Association, California Department of Parks and Recreation, California Coastal Conservancy, Monterey County Water Resources Agency (MCWRA), Monterey County Public Work Department and MPWMD. In addition, the water level data are monitored by the MCWRA via their ALERT system to enhance flood warning for residents located along the northern margin of the Lagoon and wetland.

Implementation and Activities During 2006-2007

During the 2006-2007 period, District staff continued to maintain the continuous water level recorder located in the South Arm of the Lagoon, and a complete record of water level readings (i.e., 15 minute intervals) was obtained. In September 2007, staff installed a cellular modem, solar panel and antenna at the site enabling real time access to water level data from the District office. These continuous water level data are plotted and posted on the District website under the Carmel River Lagoon water levels section approximately weekly. This allows interested parties to access the data to view recent water level trends.

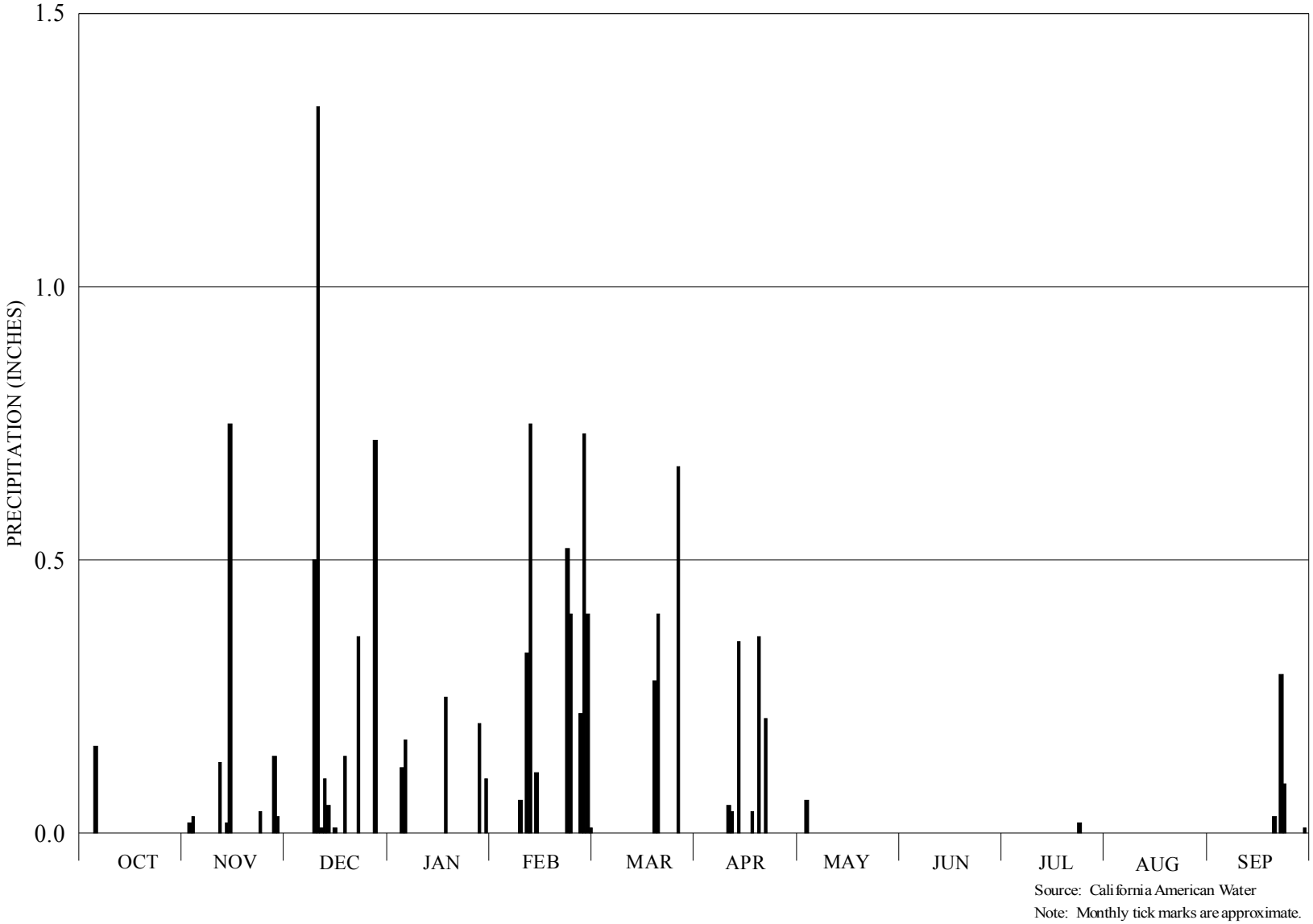
The monthly plot for February 2007 shown in **Figure II-18** illustrates the first lagoon opening of the 2006-2007 rainy season, on February 11, 2007. Prior to this event, the lagoon mouth was closed, with an inflow to the lagoon of about 10 cfs. Given the already high lagoon level of close to nine feet and an increasing river flow due to a recent rainstorm, the Monterey County Public Works Department (MCPWD) opened the lagoon mouth using bulldozers. The method of opening the lagoon mouth was similar to the previous season's efforts as an outflow channel angled toward the south was cut, allowing outflow to exit over an existing bedrock sill. This method was effective at preventing the lagoon volume from completely evacuating in a matter of hours, as it has done in many prior years. Over the next several days following the initial breach, the outflow channel began to migrate from a southerly direction to a westerly direction, causing the lagoon level to slowly drop. This is illustrated in **Figure II-18** over the February 11 to 15 period. The "fin" shaped portions of the hydrograph in mid to late February represent mouth closure/breach sequences where the lagoon mouth closed (February 16) allowing the lagoon to fill from river inflow, and followed by an eventual breach and release of lagoon volume (February 19).

OBSERVED TRENDS, CONCLUSIONS AND/OR RECOMMENDATIONS:

Streamflow and precipitation data continue to provide a scientific basis for management of the water resources within the District. These data continue to be useful in Carmel River Basin planning studies, reservoir management operations, water supply forecast and budgeting, and defining the baseline hydrologic conditions of the Carmel River Basin. The District's streamflow monitoring program continues to produce high quality data in a cost-effective manner.

U:\Darby\wp\allocation\RY 2007\final\ii_water_resources_.doc
Prepared by Water Resources Division
Finalized: August 21, 2009

Figure II-1
San Clemente Reservoir Daily Rainfall: Water Year 2007



Source: California American Water
Note: Monthly tick marks are approximate.

Figure II-2
Monthly Distribution of Rainfall at San Clemente Reservoir: Water Year 2007 v. Average Conditions

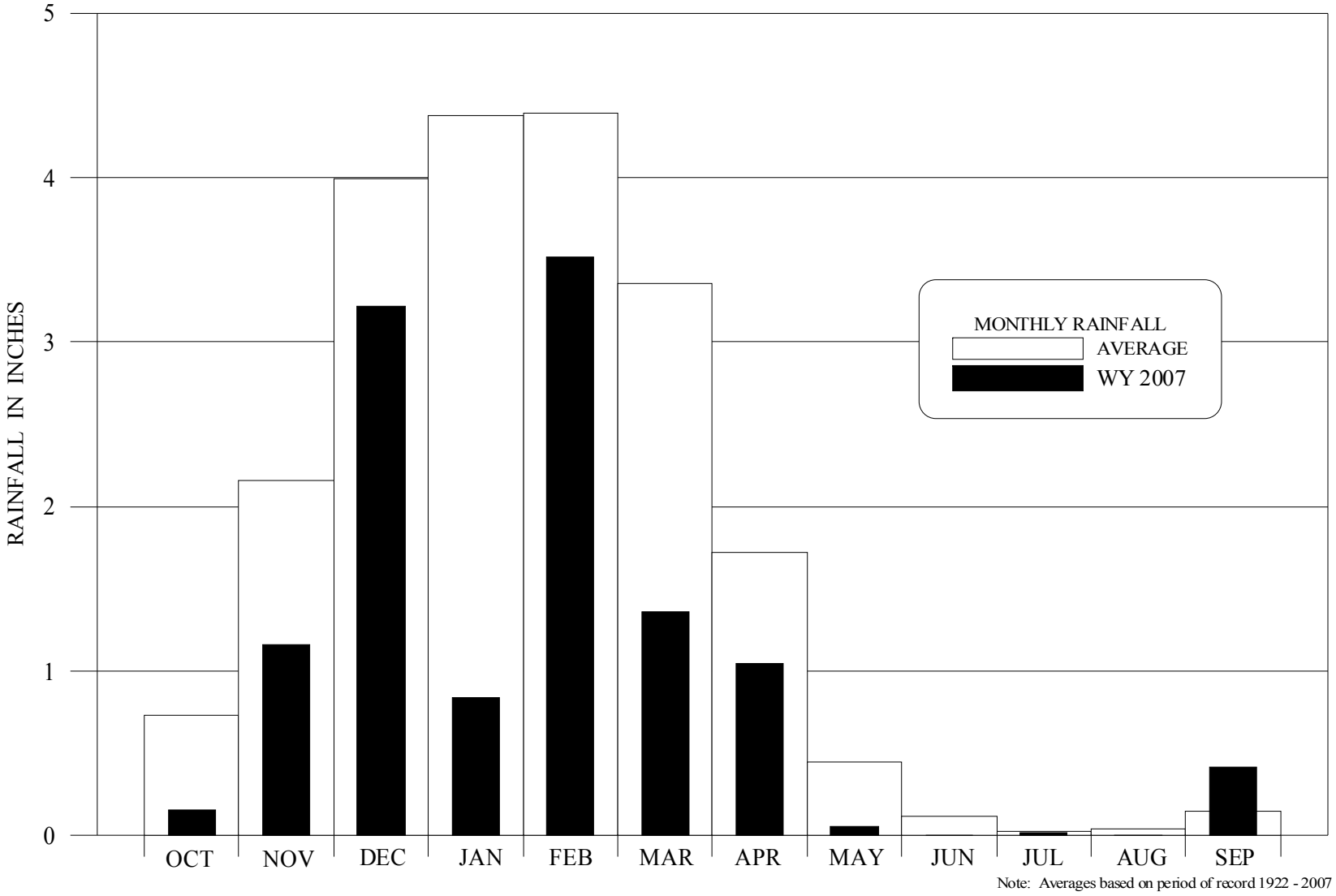


Figure II-3
Carmel River Basin Principal Streamflow Gaging Stations

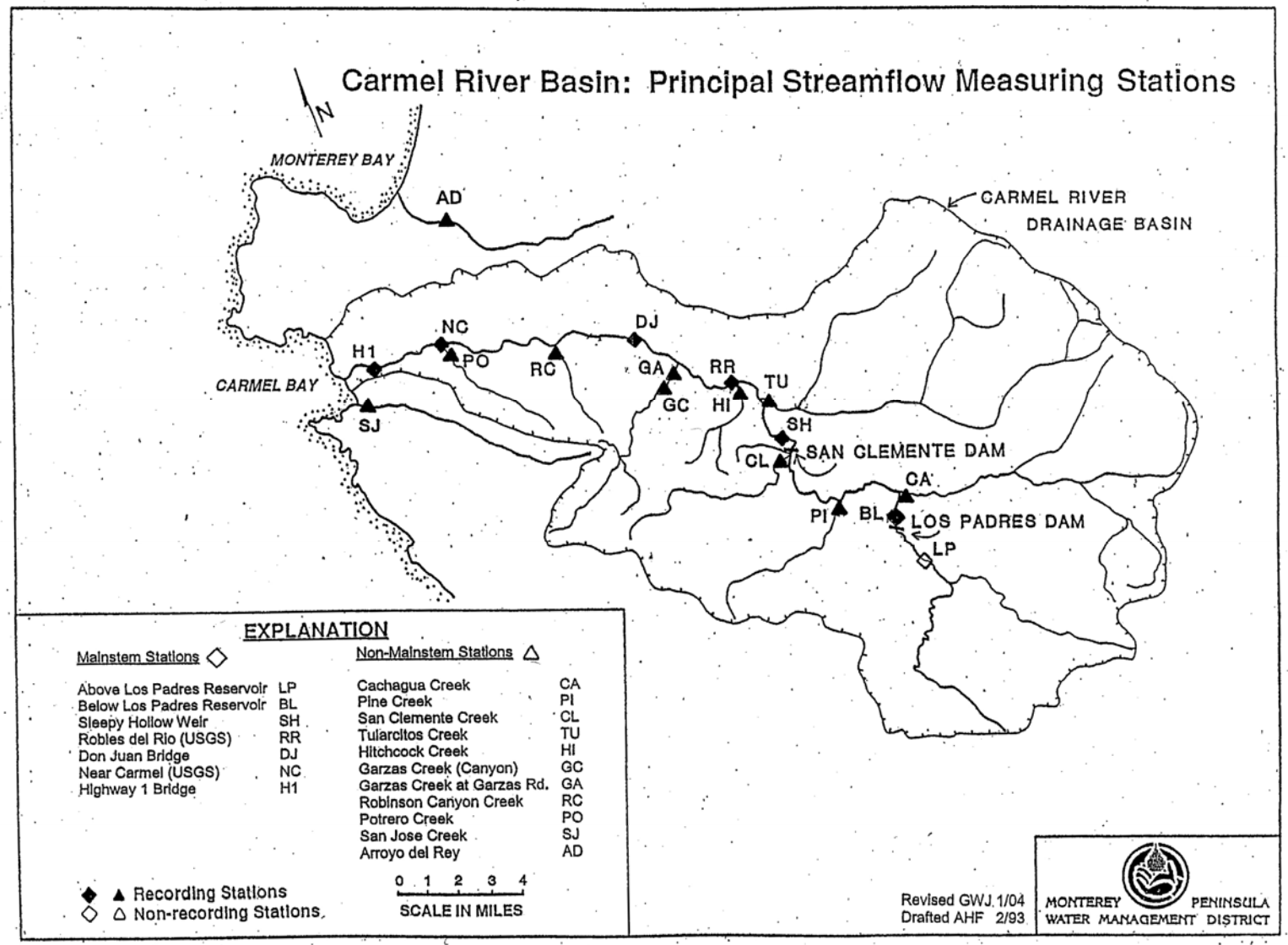


Figure II-4
Cumulative Unimpaired Runnoff: Carmel River at San Clemente Dam

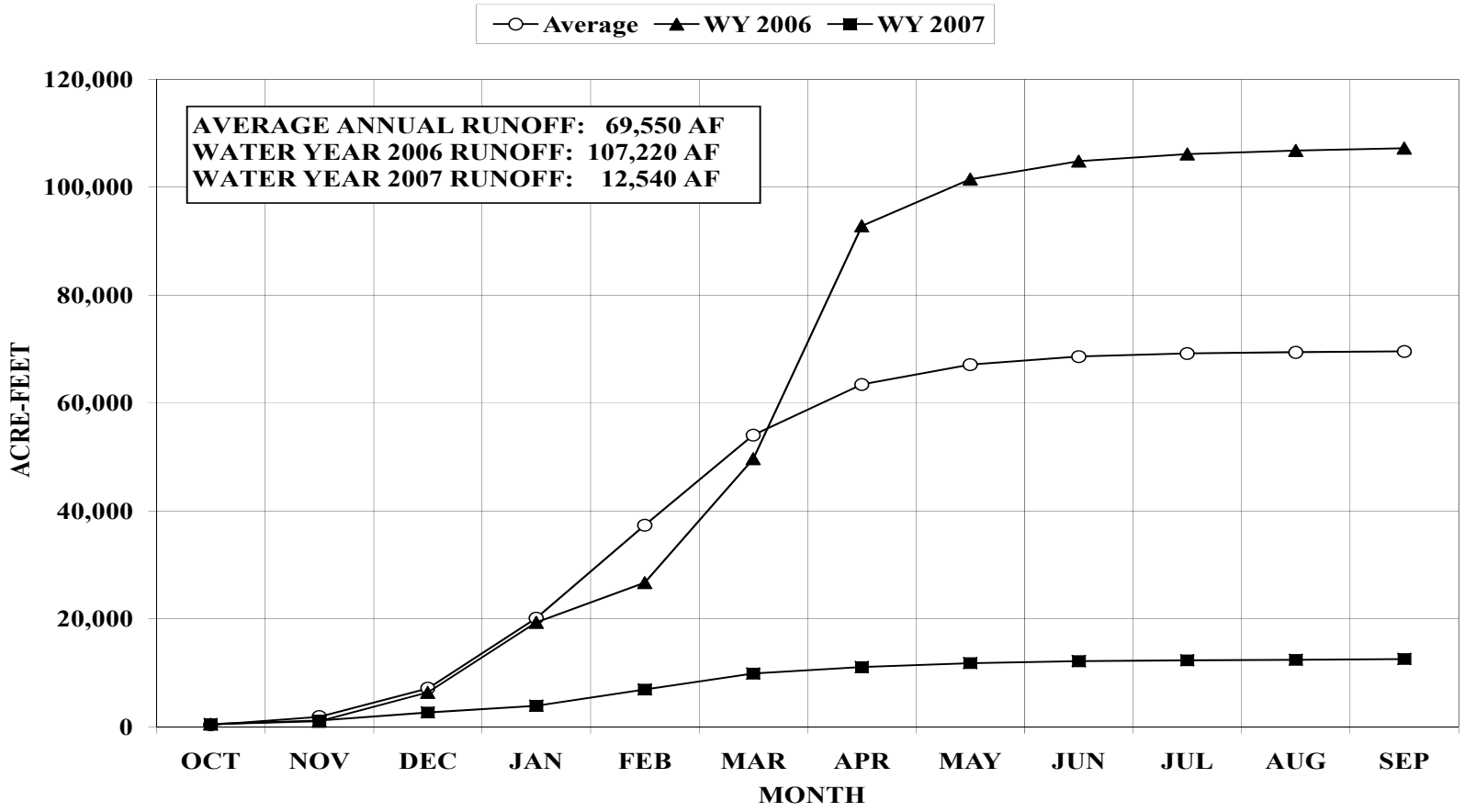


Figure II-5
End-of-Month Usable Storage for the Monterey Peninsula Water Resources System: Water Year 2007

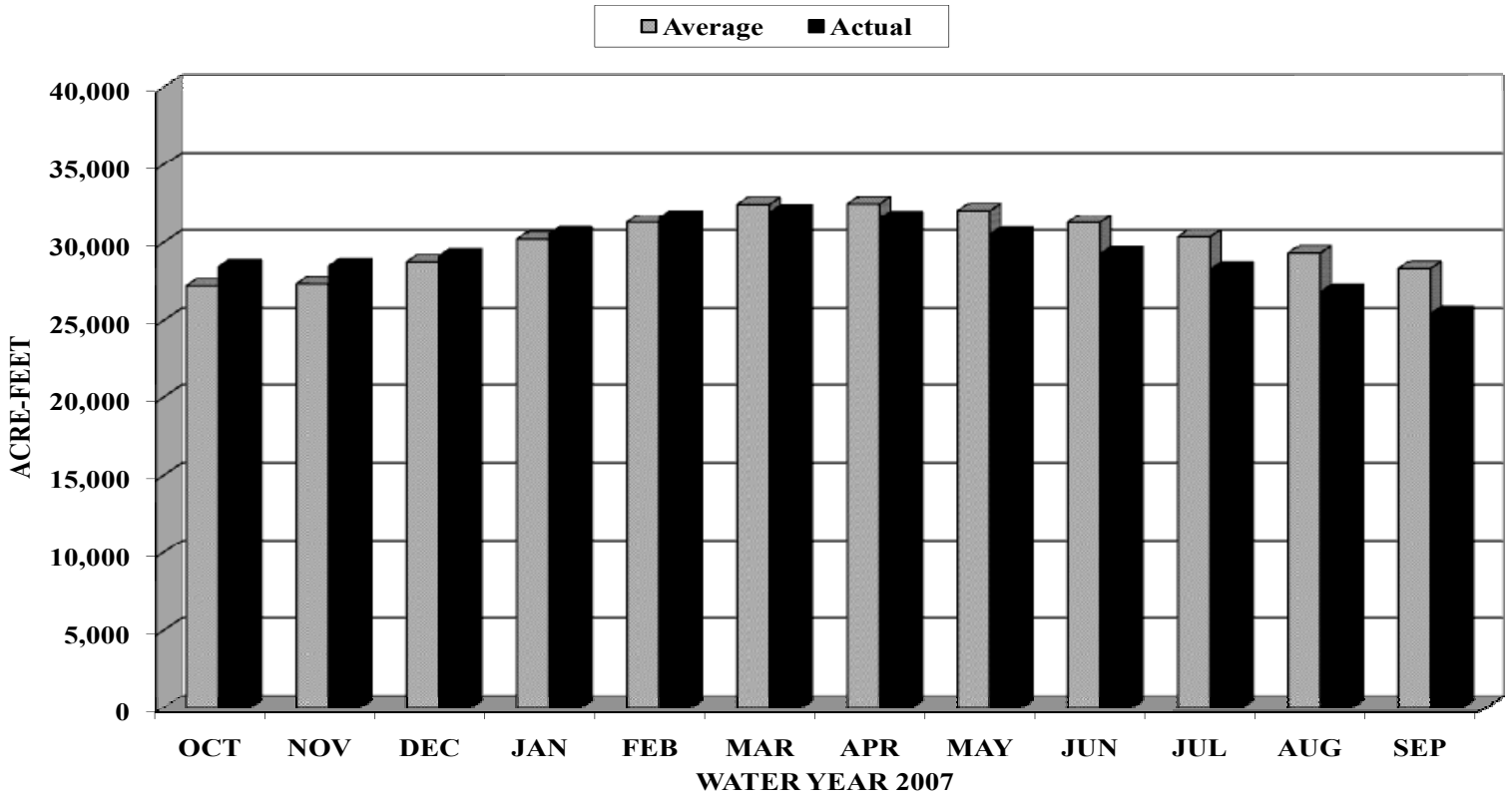


Figure II-6
Mean Daily Streamflow and Groundwater Elevation at the Rancho Canada East Well

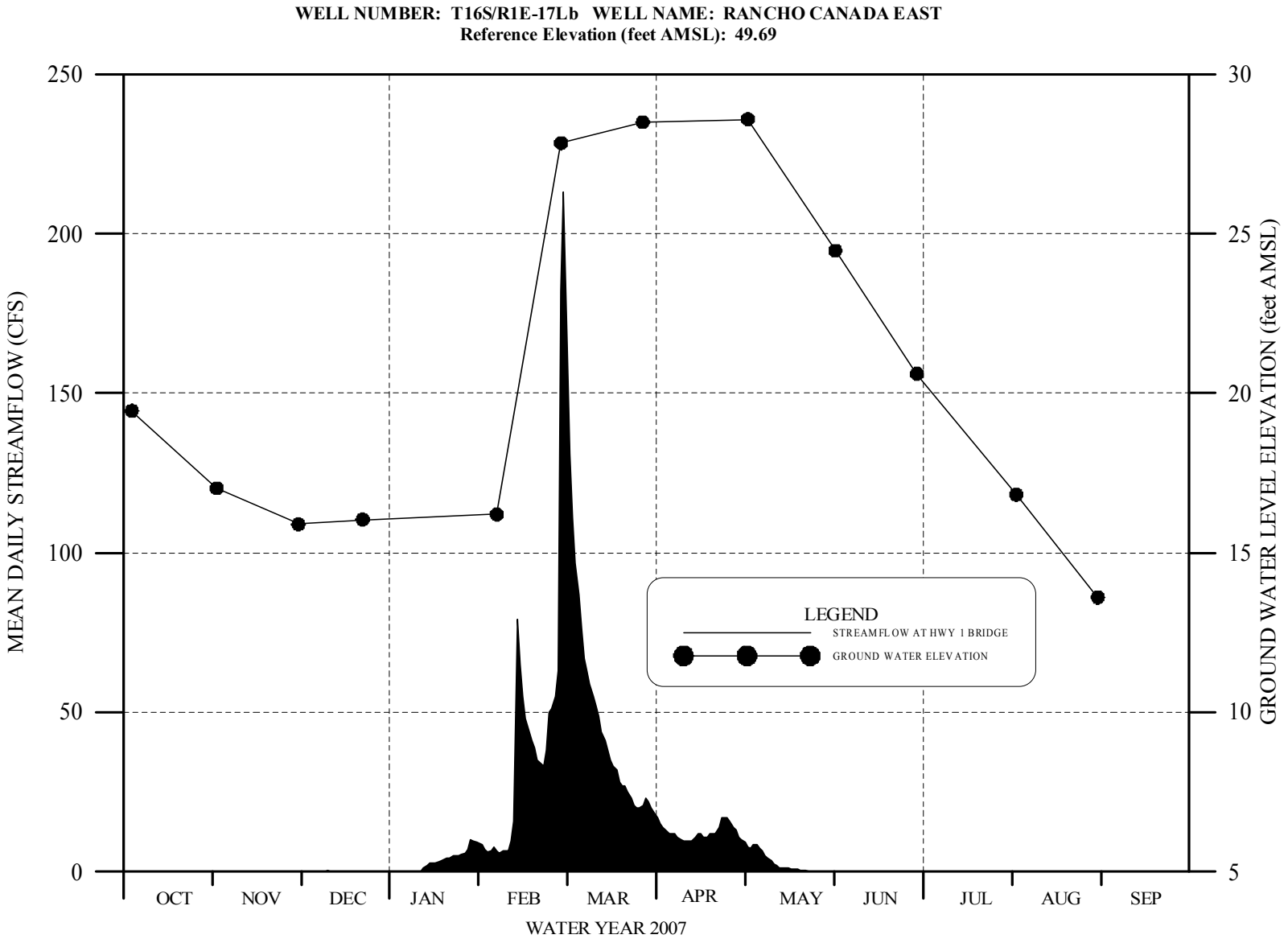


Figure II-7
Mean Daily Streamflow and Groundwater Elevation at the CAWD Rio North Well.

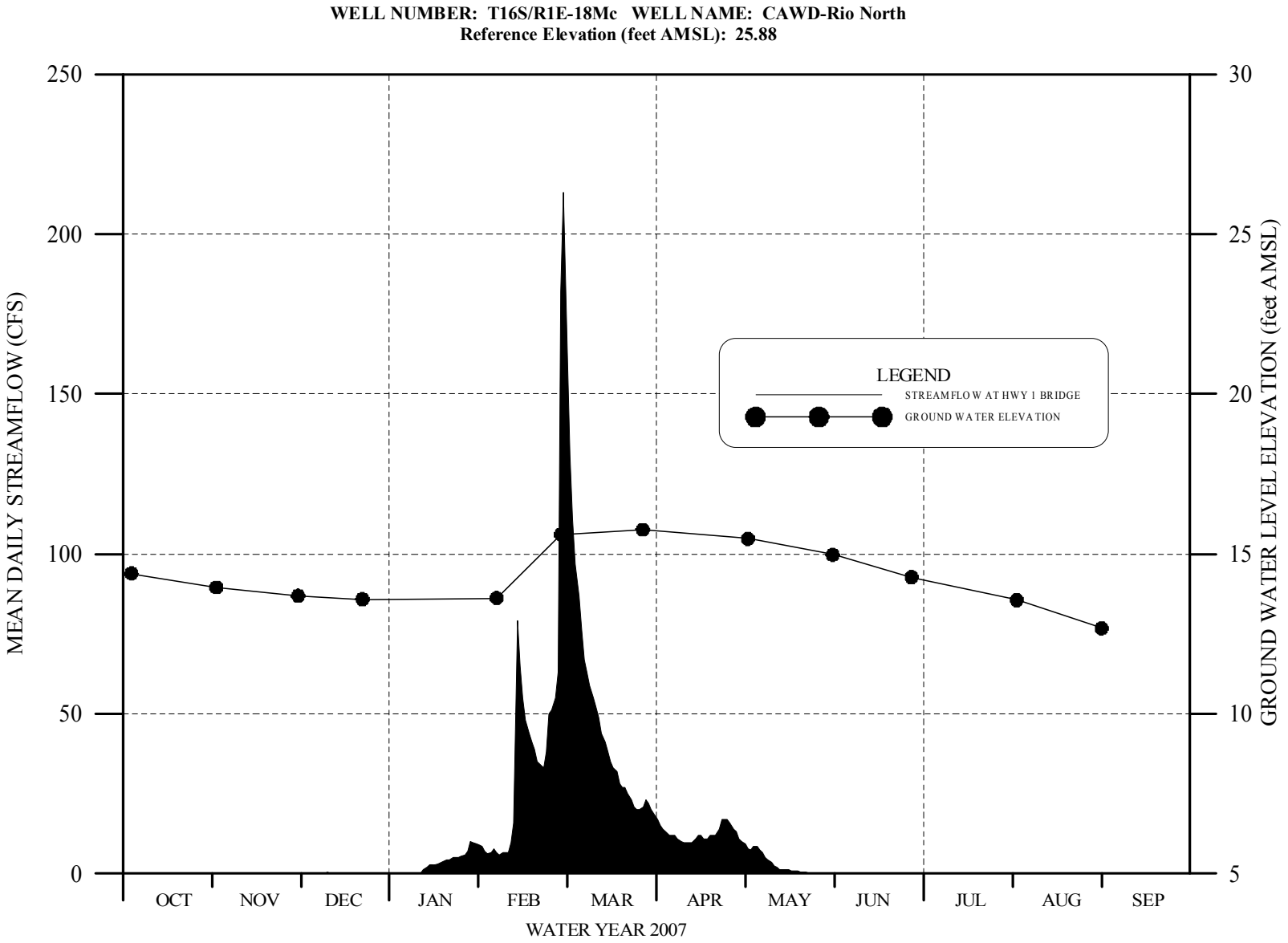
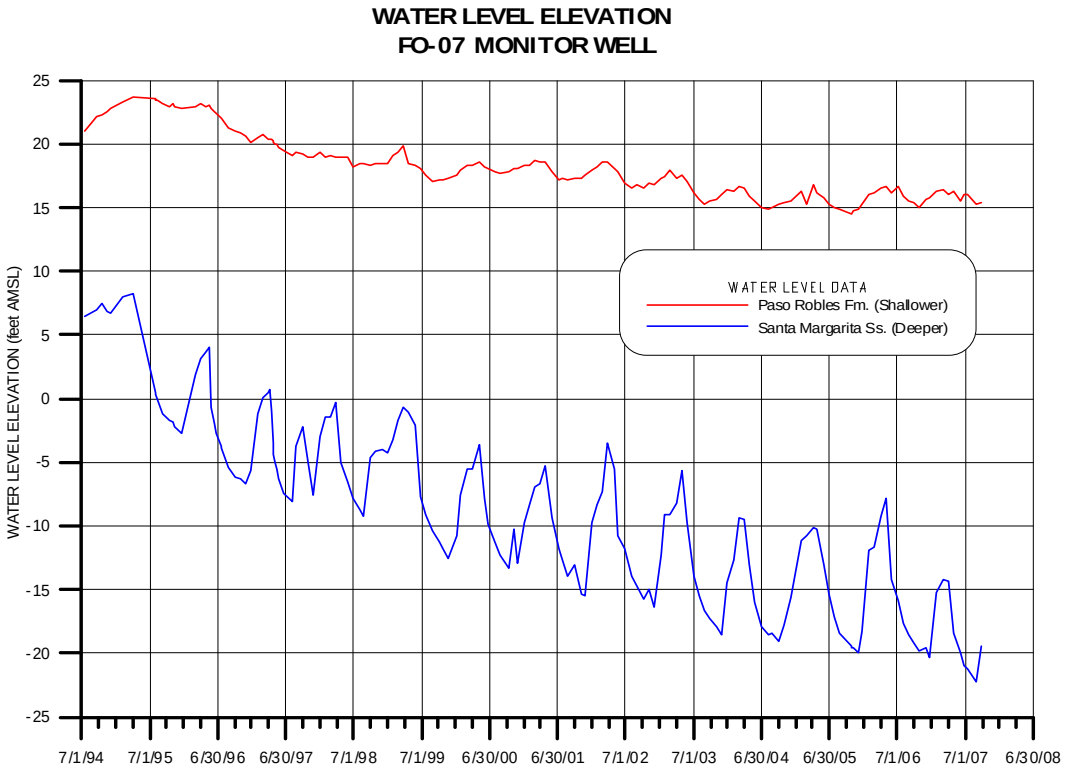


Figure II-8
Seaside Basin Groundwater Monitoring Wells
MONTEREY PENINSULA WATER MANAGEMENT DISTRICT



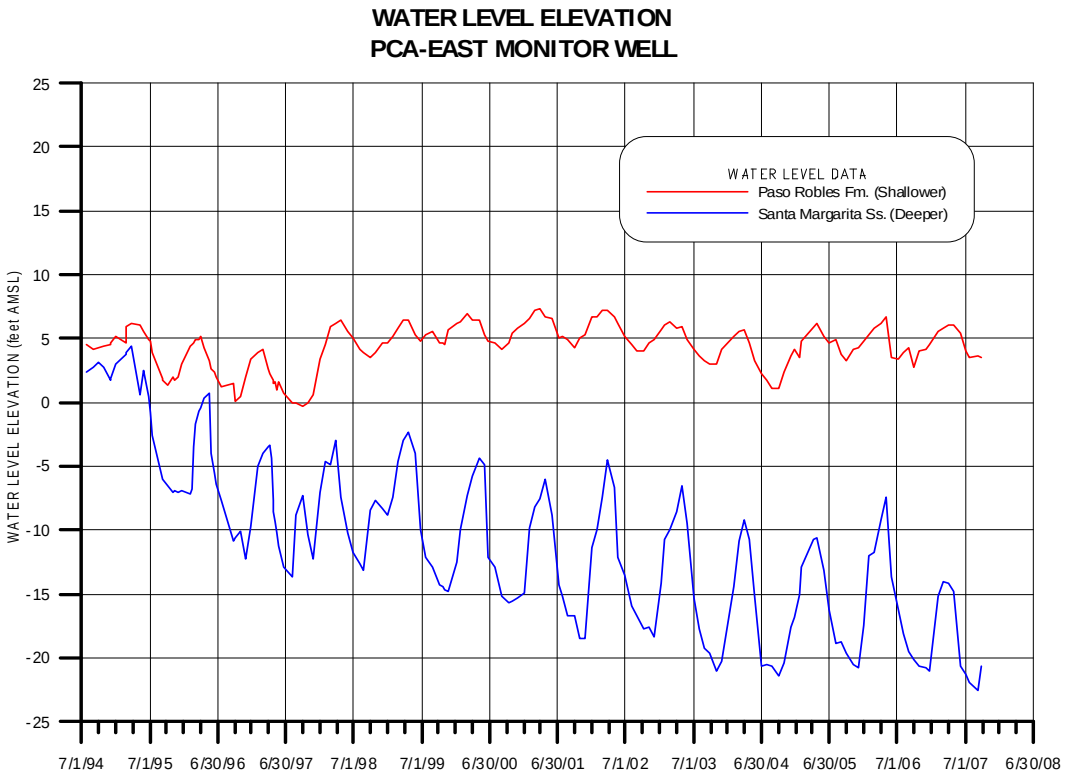


Figure II-9a
Water Quality 0.07 Miles from the Coast in Carmel Valley

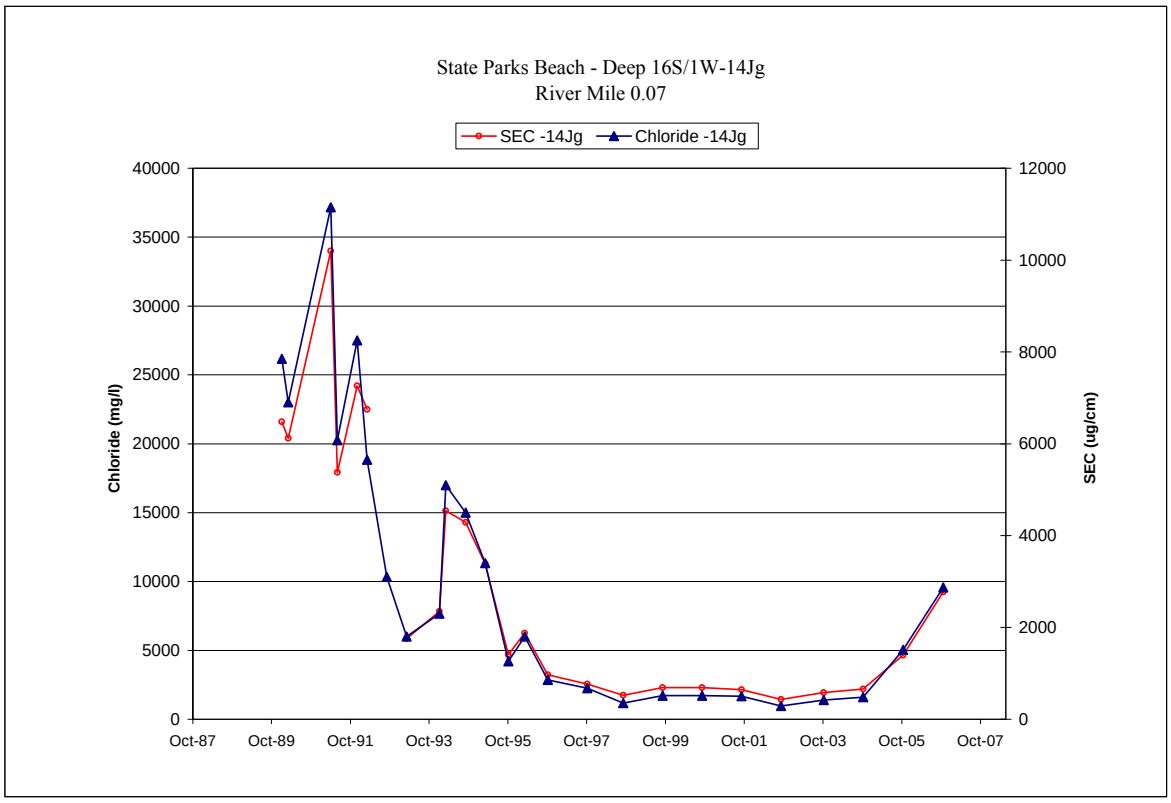


Figure II-9b
Water Quality 0.31 Miles from the Coast in Carmel Valley

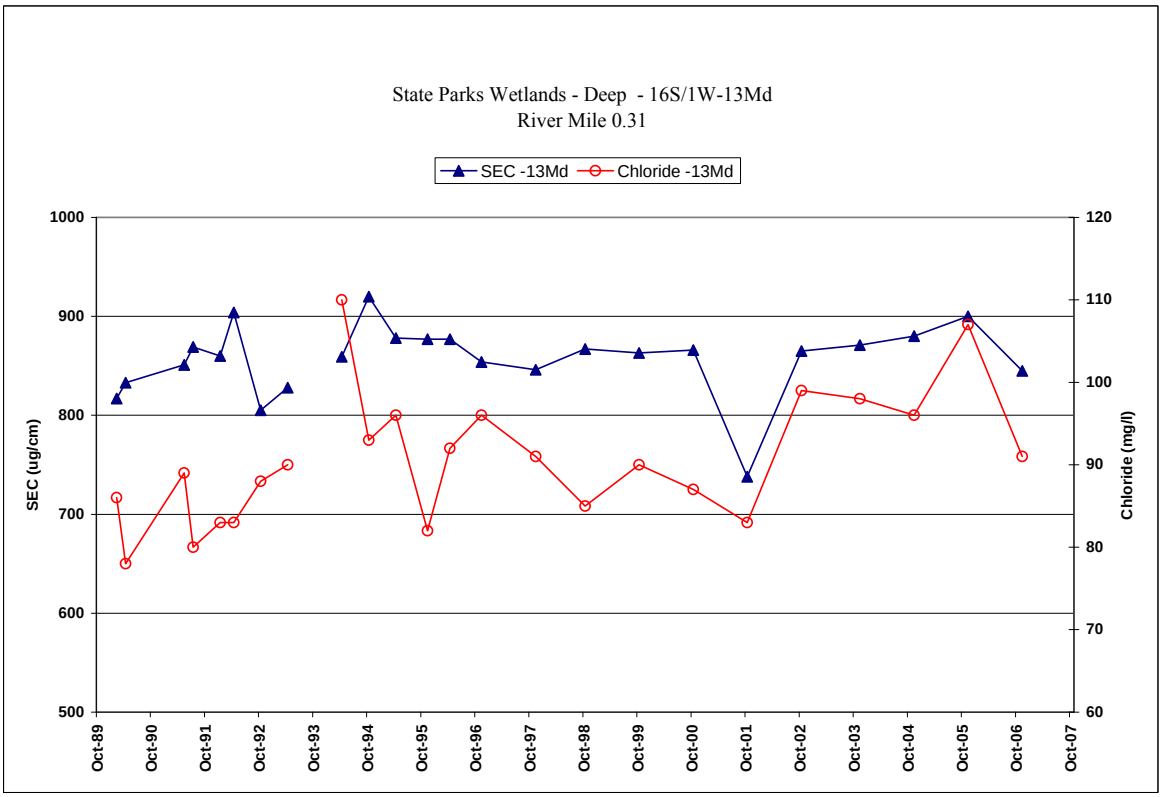


Figure II-9c
Water Quality 0.65 Miles from the Coast in Carmel Valley

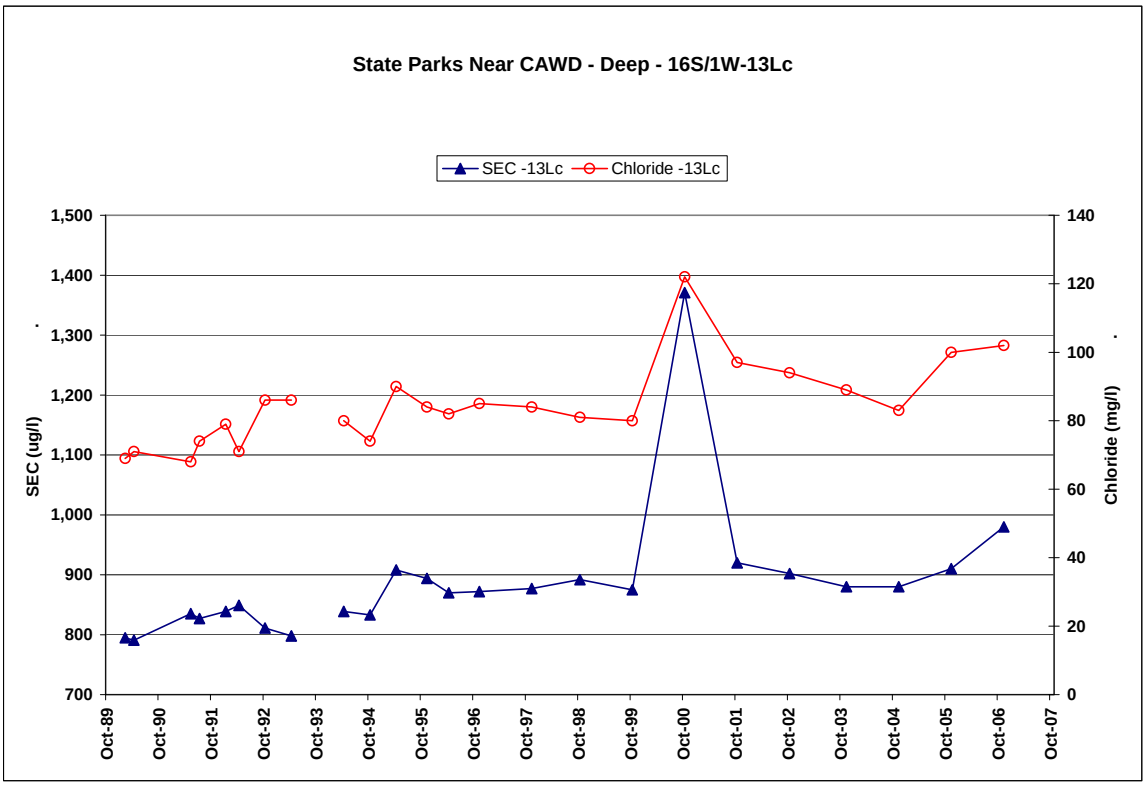


Figure II-9d
Water Quality 6.72 Miles from the Coast in Carmel Valley

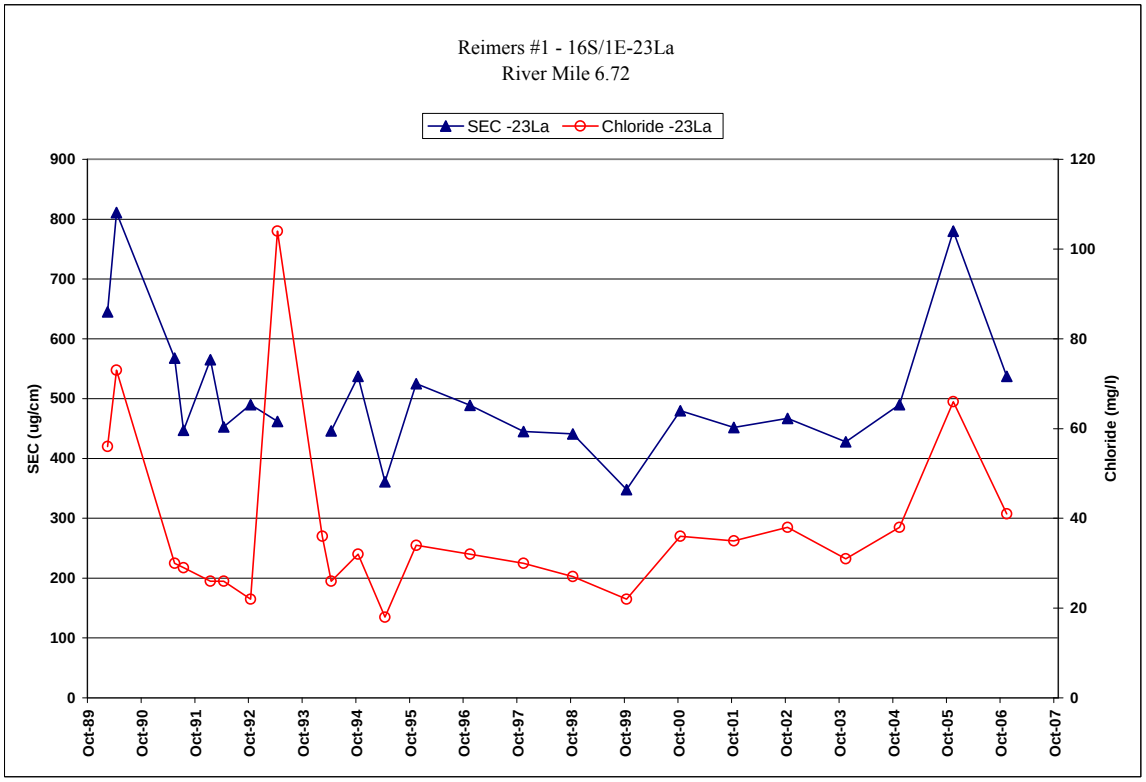


Figure II-9e
Water Quality in Two Coastal Wells in the Seaside Groundwater Basin

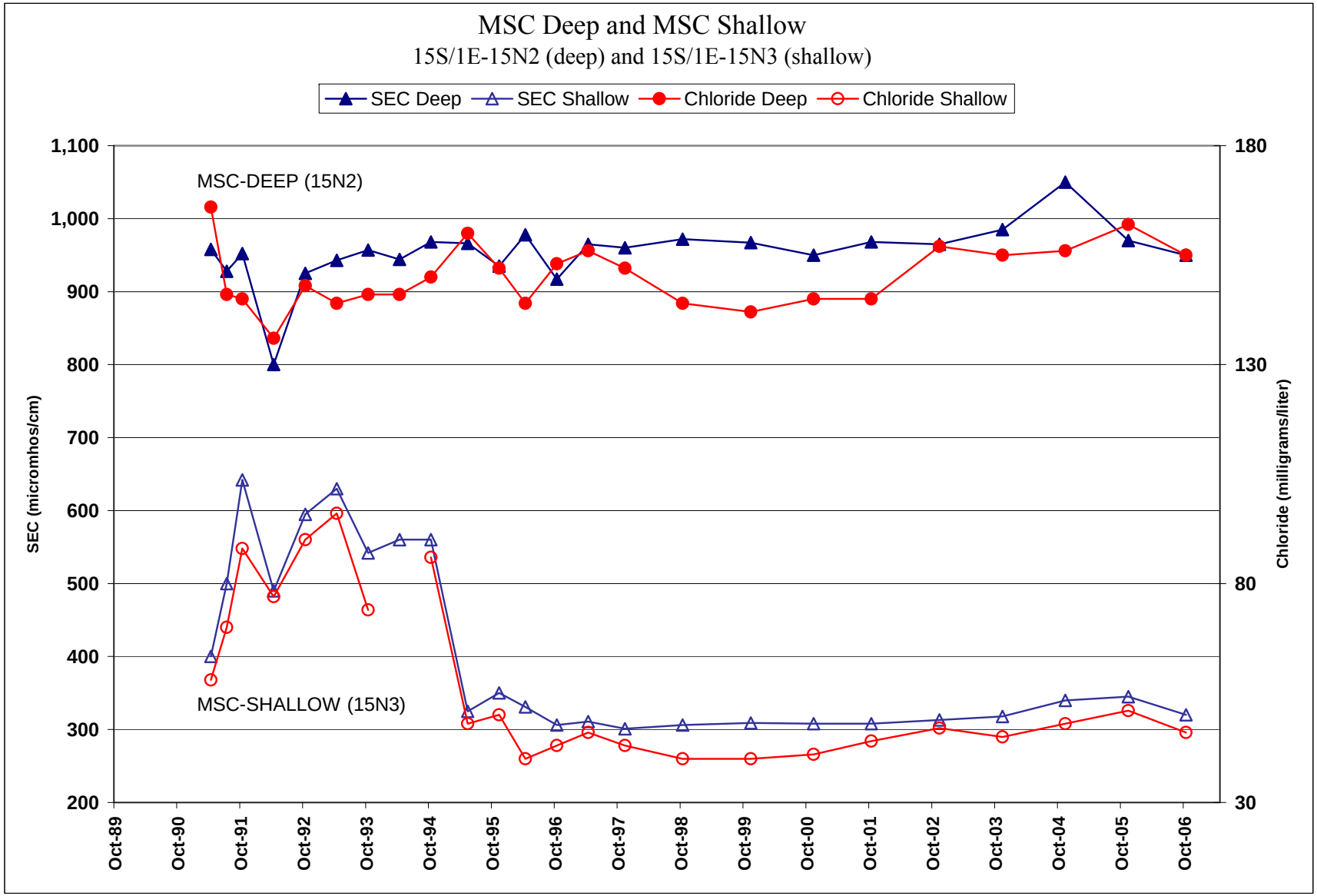


Figure II-10
Temperature and Semi-Monthly Water Quality Monitoring Locations Within the Carmel River Basin During RY 2007

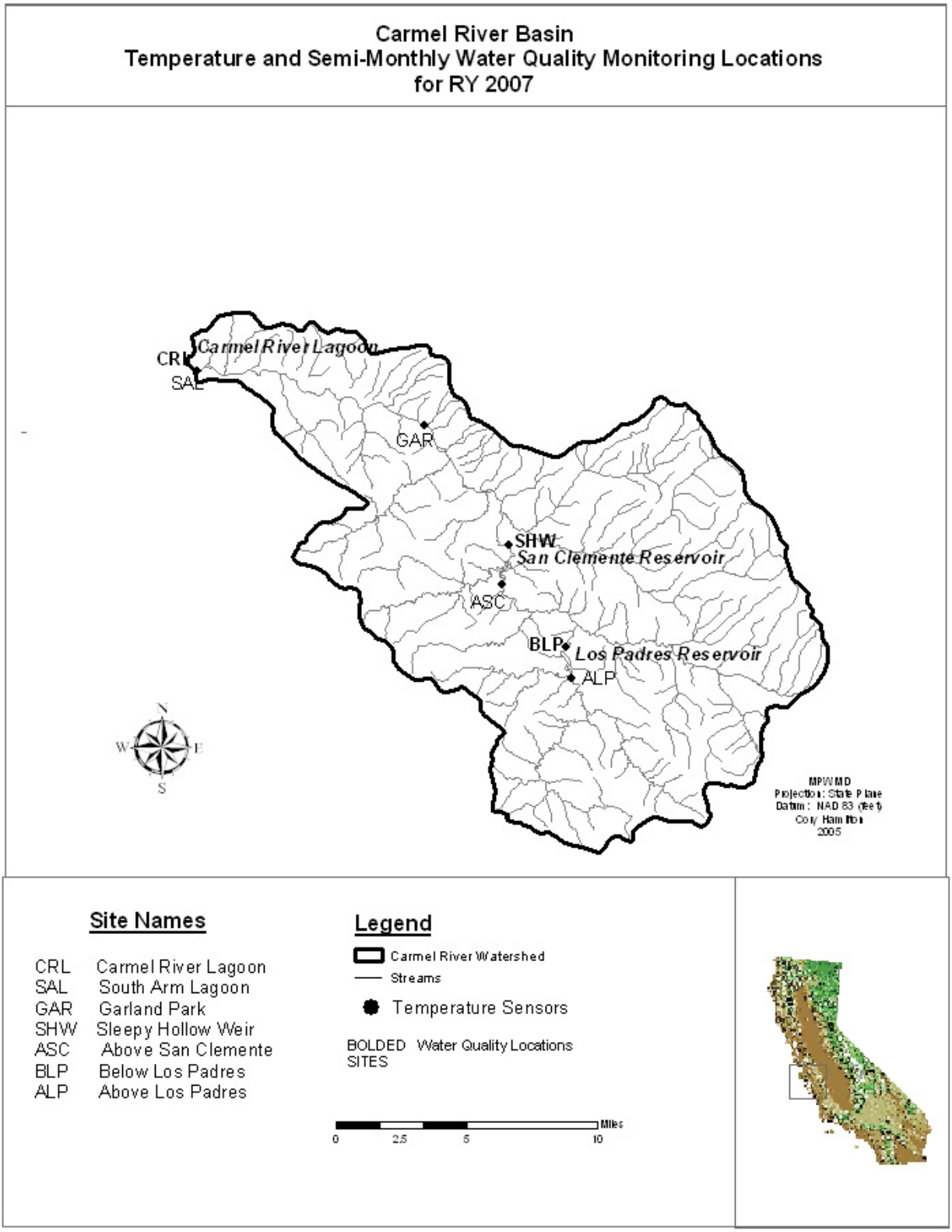


Figure II-11
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the South Arm Lagoon (SAL) Station During RY 2007

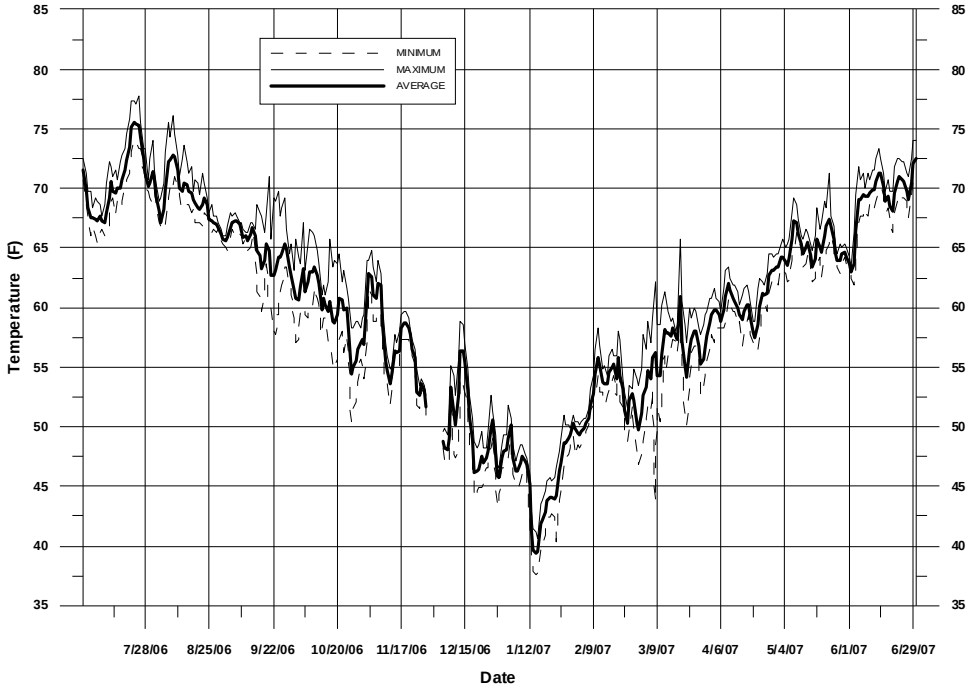


Figure II-12
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Garland Park (GAR) Station During RY 2007

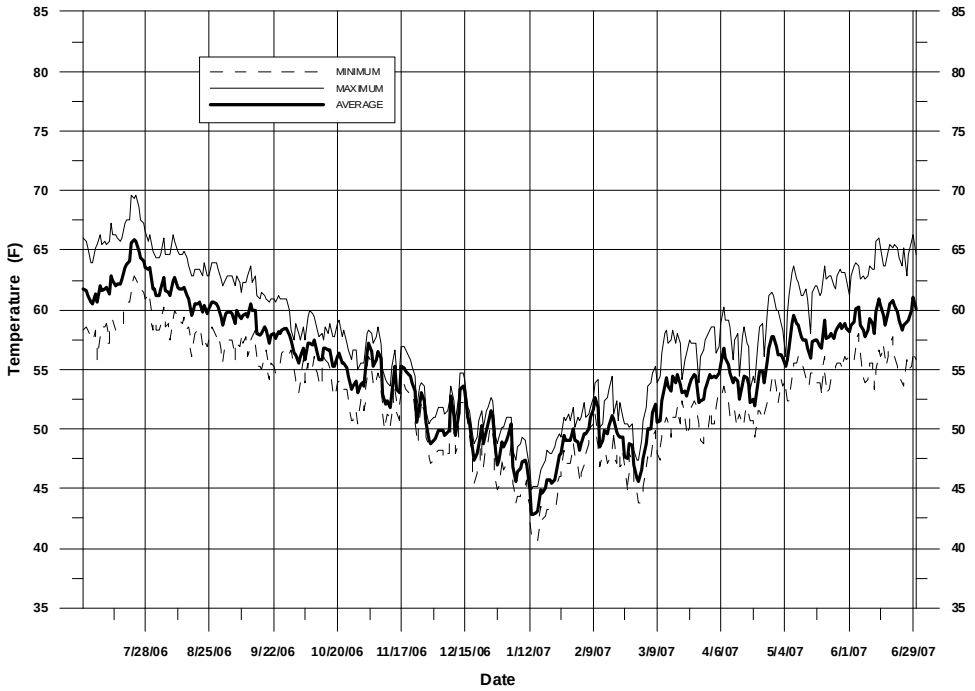


Figure II-13
Daily Temperatures Recorded from a Continuous Temperature Data Logger At The Sleepy Hollow Weir (SHW) Station During RY 2007

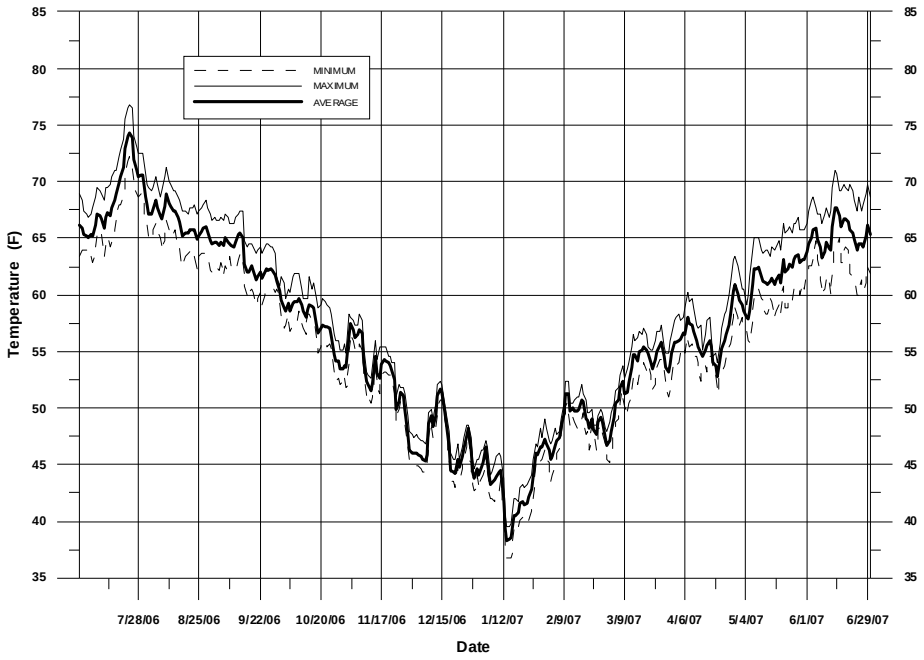


Figure II-14
Daily Temperatures Recorded From a Continuous Temperature Data Logger at the Above San Clemente (ASC) Station During RY 2007

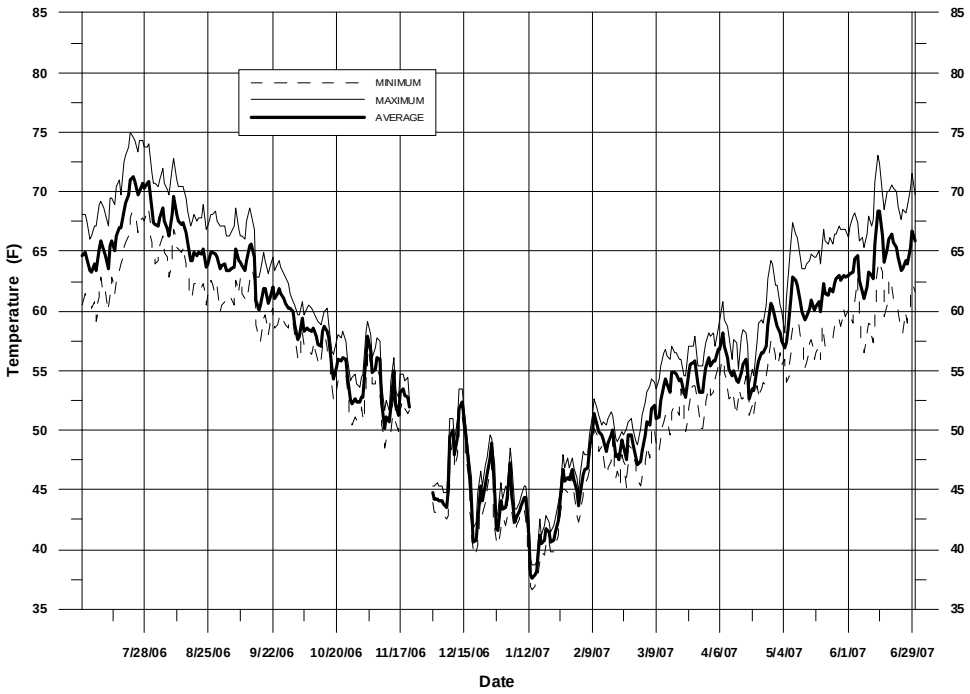


Figure II-15.
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Below Los Padres (BLP) Station During RY 2007

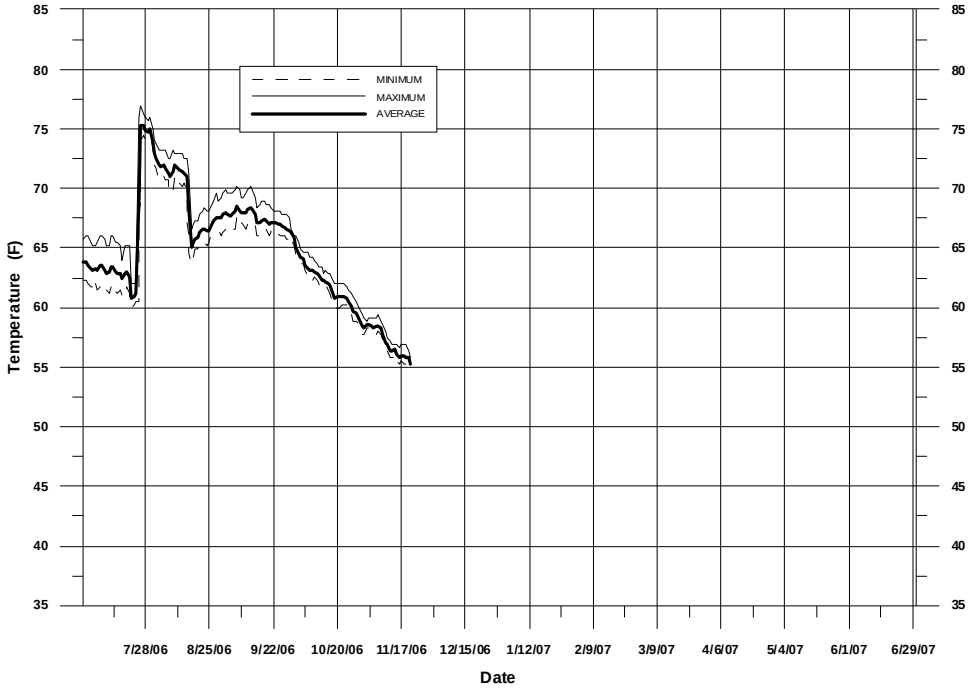


Figure II-16
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Above Los Padres (ALP) Station During RY 2007

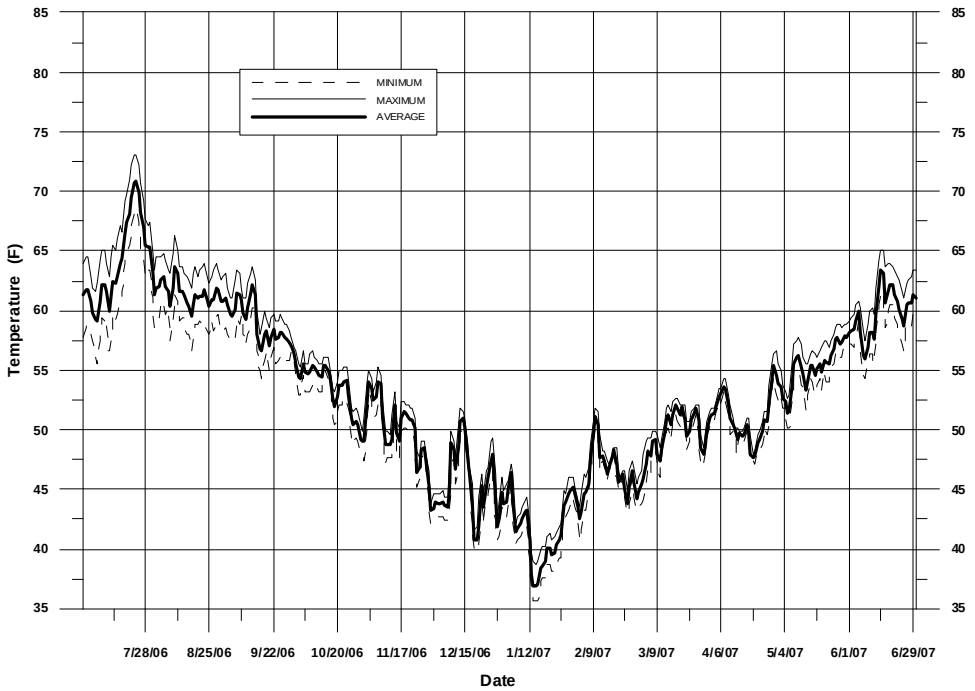


Figure II-18
Carmel River Lagoon Water Level: February 2007

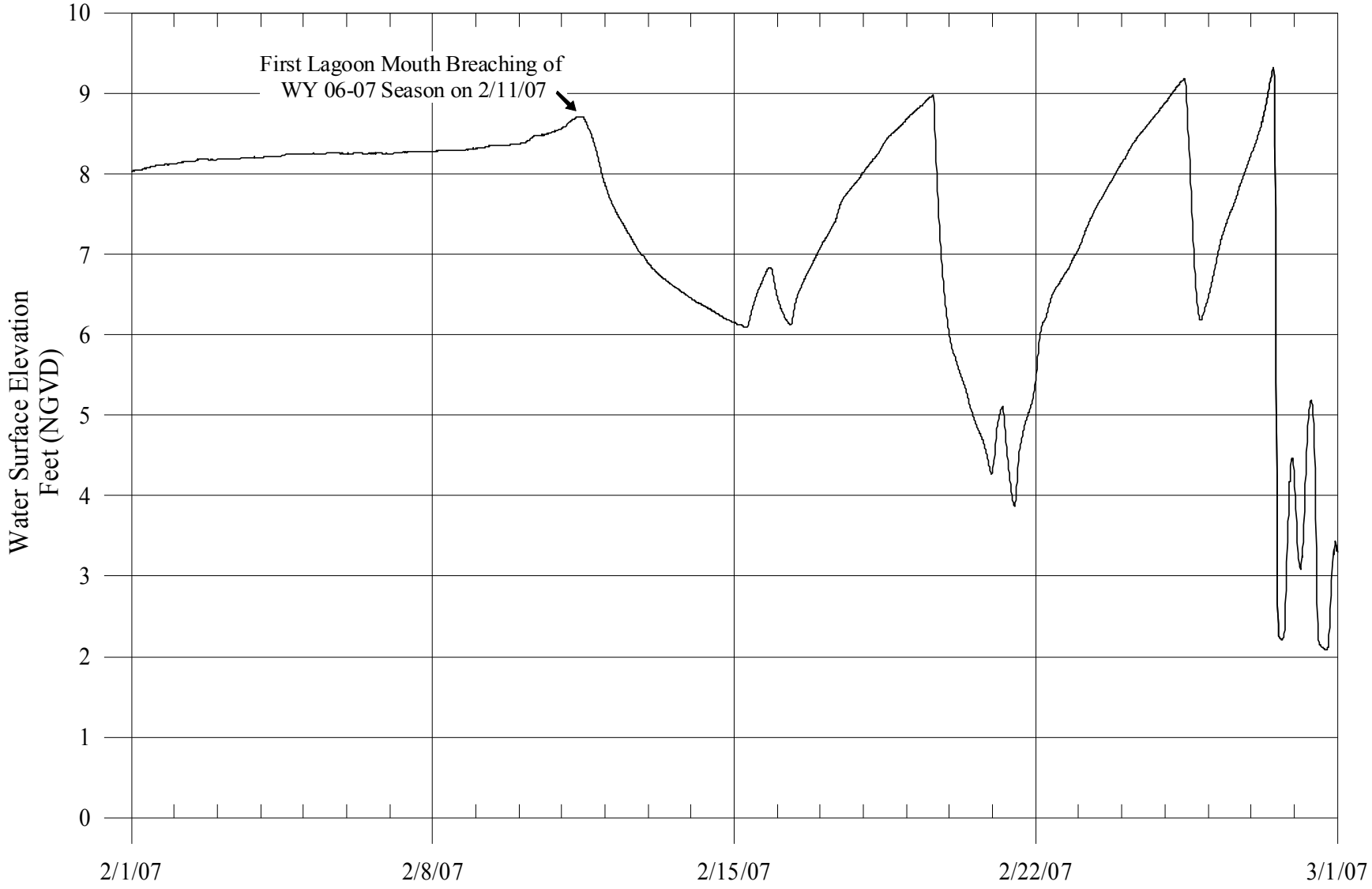


Table II-1
Carmel River Basin Total Annual Streamflow: Water Years 1992 – 2007

TRIBUTARY SITES	Drainage Area (Sq. Miles)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CACHAGUA CREEK	46.3	1,780	7,340	560	16,320	3,840	4,990	23,800	2,590	1,730	1,500	245	1,270	1,250	4,340	5,210	261
PINE CREEK	7.8	3,750	9,800	1,230	11,110	6,550	8,300	15,610	4,540	5,300	3,270	2,300	4,250	2,410	9,300	8,020	847
SAN CLEMENTE CREEK	15.6	5,450	17,070	1,820	20,580	9,310	14,100	33,380	7,130	9,830	5,340	3,270	5,850	3,720	16,330	13,720	1,360
TULARCITOS CREEK	56.3	635	3,220	444	5,100	1,650	2,450	22,610	3,810	2,450	1,490	630	552	503	1,000	2,480	503
HITCHCOCK CREEK	4.6	*	*	52	1,820	451	716	2,970	169	482	214	18	274	234	863	691	2
GARZAS CREEK	13.2	3,700	11,170	746	12,140	4,890	8,570	24,610	5,050	4,980	3,070	1,200	2,760	1,700	8,590	7,420	381
ROBINSON CANYON CREEK	5.4	619	2,360	89	2,230	619	1,430	6,890	545	823	433	82	448	354	1,710	1,010	25
POTRERO CREEK	5.2	*	*	30	1,790	506	1,210	5,970	855	1,020	310	43	210	163	1,470	1,050	13
SAN JOSE CREEK (outside CRB)	14.2	*	*	*	*	*	*	*	6,400	6,260	2,890	1,100	1,880	1,480	7,640	6,870	862
MAINSTEM SITES																	
CR AT ROBLES DEL RIO	193	38,240	109,000	11,800	155,000	75,210	99,340	250,300	54,640	76,750	47,180	31,850	60,560	38,060	114,400	110,100	12,240
CR AT DON JUAN BRIDGE	216	*	122,000	12,760	173,600	83,090	111,800	252,200	53,570	73,960	49,360	31,330	60,420	38,350	121,900	118,700	12,150
CR NEAR CARMEL	246	35,570	123,400	8,200	177,400	74,500	104,100	261,100	55,000	76,190	47,790	28,340	55,400	35,220	119,200	119,200	7,460
CR AT HIGHWAY 1 BRIDGE	252	*	123,000	7,410	179,500	83,430	112,000	280,900	50,810	72,660	42,860	24,860	52,000	30,300	116,600	111,700	6,570

Notes: 1. Carmel River (CR) at Robles del Rio and near Carmel sites are maintained by the USGS.
2. (*) No continuous stage data collected.
3. Streamflow sites listed in downstream order.
4. San Jose Creek is outside the Carmel River Basin, but is shown for comparison.
5. Water Years 2004 - 2007 figures are provisional and subject to change.

Table II-2
Water Quality Data Collected by MPWMD During RY 2007 at Carmel River Lagoon (CRL) Site[1].

Date	Time 24 Hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Nacl (ppt)	Turbidity (NTU)	WSE (ft)
07-Jul-06	1307	70.2	9.2	10.0	8.0	517	.35	0.3	6.47
21-Jul-06	1500	71.0	9.0	10.0	7.5	563	.25	0.3	7.08
25-Aug-06	1250	66.9	10.0	10.0	8.0	1305	.9	0.7	4.06
06-Sep-06	1220	70.3	12.2	10.0	n/a	1028	1.35	0.5	3.4
20-Oct-06	1220	61.9	12.1	10.0	8.5	7220	1.1	4.0	4.1
14-Nov-06	1231	59.7	11.3	10.0	8.0	10470	4.5	6.0	5.08
28-Nov-06	1338	53.8	15.3	10.0	7.9	8170	1.1	4.6	4.98
20-Dec-06	1408	46.8	n/a	10.0	7.4	6670	n/a	3.7	5.58
10-Jan-07	1230	48.4	16.0	10.0	8.0	5210	1.7	3.0	5.71
08-Feb-07	1230	52.7	9.5	10.0	8.0	1570	1	0.8	8.29
23-Feb-07	1245	54.3	10.0	10.0	8.0	829	.4	3.3	7.72
16-Mar-07	1245	59.9	10.0	10.0	8.0	597	0	0.3	7.89
06-Apr-07	1020	59.0	9.0	10.0	8.0	1724	0	0.9	7.39
02-May-07	1245	65.8	9.0	15.0	7.5	788	1.35	0.4	9.28
01-Jun-07	1250	64.6	9.0	30.0	8.0	1777	0	0.9	5.9
Minimum		46.8	9.0	10.0	7.4	517	0	0.30	
Maximum		71.0	16.0	30.0	8.5	10470	4.5	6.0	
Average		60.4	10.8	11.7	7.9				

[1]The CRL station is located on the southwest end of the main body of the Lagoon, along the rock outcrop at River Mile (RM) 0.1.

Table II-3.
Water Quality Data Collected by MPWMD During RY 2007 at Sleepy Hollow Weir (SHW) Site[1].

Date	Time 24 hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Turbidity (NTU)
07-Jul-06	1100	66.0	9.3	10.0	8.0	315	1
21-Jul-06	1145	70.0	10.0	10.0	8.0	278	4.5
25-Aug-06	1030	64.2	12.6	10.0	8.0	280	6.9
06-Sep-06	1100	66.4	9.6	10.0	n/a	330	6.65
20-Oct-06	1120	57.2	11.6	10.0	8.0	325	2.85
14-Nov-06	1112	55.4	12.6	10.0	8.0	352	3.2
28-Nov-06	1040	49.8	13.6	10.0	8.0	252	3.1
20-Dec-06	1245	46.2	n/a	10.0	7.9	333	n/a
10-Jan-07	1120	44.2	15.5	10.0	7.5	320	3.1
08-Feb-07	1110	48.2	11.0	15.0	8.0	335	3
23-Feb-07	1105	48.2	11.0	10.0	8.0	273	.2
16-Mar-07	1030	53.4	11.0	10.0	8.0	264	0
06-Apr-07	1245	57.9	9.0	10.0	8.0	312	.5
02-May-07	1045	59.0	10.0	5.0	8.0	303	0
01-Jun-07	1125	64.4	9.0	10.0	7.5	320	0
Minimum		44.2	9.0	5.0	7.5	252	0.0
Maximum		70.0	15.5	15.0	8.0	352	6.9
Average		56.7	11.1	10.0	7.9	306	

[1] The SHW station is located 15 ft downstream of the Sleepy Hollow Weir at RM 17.1.

Table II-4.
Water Quality Data Collected by MPWMD During RY 2007 at Below Los Padres (BLP) Site[1].

Date	Time 24 hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Turbidity (NTU)
07-Jul-06	0930	62.6	8.5	10.0	7.5	299	1.3
21-Jul-06	1300	66.0	8.0	15.0	7.0	254	1.9
25-Aug-06	1141	65.7	8.1	10.0	7.5	262	3.8
06-Sep-06	0945	67.3	7.6	10.0	7.5	307	4.8
20-Oct-06	0942	62.2	8.6	10.0	7.5	322	2.25
14-Nov-06	1003	57.4	9.6	10.0	7.5	323	1.1
28-Nov-06	0937	54.3	10.9	10.0	7.3	315	3.2
20-Dec-06	1100	46.6	n/a	10.0	7.8	307	n/a
10-Jan-07	0955	46.0	12.5	10.0	7.5	294	1
08-Feb-07	1015	46.4	10.0	10.0	7.5	292	.9
23-Feb-07	1020	49.1	10.0	10.0	7.5	241	0
16-Mar-07	0945	52.2	10.0	10.0	7.5	233	0
06-Apr-07	1145	56.8	9.0	5.0	7.5	266	.05
02-May-07	0937	58.1	9.0	10.0	7.0	259	0
01-Jun-07	0956	59.7	4.0	15.0	7.0	276	0
Minimum		46.0	4.0	5.0	7.0	233	0.0
Maximum		67.3	12.5	15.0	7.8	323	4.8
Average		56.7	9.0	10.3	7.4	283	

[1]The BLP station is located approximately 200 ft downstream of the Los Padres spillway at RM 25.4.